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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

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01 GENERAL

Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-14371 Stanford Research Inst., Menlo Park, Calif.
RADIOLOGICAL MONITORING: CONCEPTS AND SYSTEMS
Richard B. Bothun and Richard K. Laurino Feb. 1963 189 p 18 refs
(Contract OCD-OS-62-135)

Guidelines for design of radiological monitoring systems were developed. Constraints on the design criteria of both fixed and mobile systems were defined as dictated by the information which they must provide. Fixed monitoring systems were studied with respect to station spacing, intensity reporting levels, accuracy of equipment, and related design specifications. The operational constraints and the techniques of deployment of mobile systems were also considered. Specifications of instrument accuracy were developed from considerations of both the accuracy with which dose can be related to the biological effect and the precision of radiological information required to support civil-defense operations. The functions of monitoring instruments within shelters were reviewed, and their requirements for accuracy and range were developed. Initial investment and annual operating costs were estimated for selected systems. Author

N63-14414 Services Electronics Research Lab., Baldock (Gt. Brit.)
S.E.R.L. TECHNICAL JOURNAL, VOLUME 13, NO. 1
Feb. 1963 77 p 46 refs

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N63-14539 Aerospace Corp., El Segundo, Calif.
FLIGHT VEHICLE POWER AND MATERIALS Applied Research Programs Abstract Bulletin, Volume II, (Part I), Abstracts 2-317 through 2-398 [Quarterly Report] Oct.-Dec. 1962
K. B. Andrews et al 1962 84 p 81 refs
(Contracts AF 04(647)-930 and AF 04(695)-169)
(TDR-930(2701-01)TN-Vol. II, Pt. I, No. 4; DCAS-TN-61-3, Vol. II, Pt. I, No. 4)

This bulletin contains abstracts of the unclassified literature on the subject of flight vehicle power. Abstracts of selected references in the field of materials are also included. All abstracts are prepared from the original reports and are limited to those available within Aerospace Corporation. Author

N63-14582 National Aeronautics and Space Administration, Washington, D.C.
RESEARCHES IN SPACE FLIGHT TECHNOLOGY
Abe Silverstein Repr. from J. Roy. Aeron. Soc. (London), v. 65, no. 612, Dec. 1961 p 779-795 10 refs 49th Wilbur Wright Memorial Lecture, London, Sept. 12, 1961
(*Its* Aeronaut. Repr. 143)

Problem areas in propulsion, aerodynamics, and structures are presented. Topics discussed are: liquid hydrogen technology, storage problems, meteoroids, weightless flight, pumping of liquid hydrogen, nuclear rocket propulsion, reentry configurations, and reentry heating. A.R.B.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-14251 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FEASIBILITY OF OPTIMIZING NOZZLE PERFORMANCE FOR ORBITAL-LAUNCH NUCLEAR ROCKETS

John R. Jack Washington, NASA, Apr. 1963 26 p 7 refs
(NASA TN D-1578) OTS: $0.75

Nozzle performance for orbital-launch nuclear rockets was evaluated for a range of operating conditions and nozzle geometries. From this study, conclusions were drawn concerning (1) optimum values of nozzle area ratio and operating pressure, (2) operating conditions for favorable nozzle heat transfer, and (3) the effects of deviations from optimum conditions. In general, the nozzle efficiency increases with both increasing divergence angle and increasing stagnation-pressure level. For a given set of conditions, however, the nozzle efficiency increases with increasing area ratio only until the gains in performance due to additional expansion are offset by the increase in convective heat transfer. The variation of specific impulse with pressure is maximized at a pressure level that depends upon the pressure at which the flow freezes. On the basis of heat transfer, operation on the low-pressure side of the optimum point is desirable. This mode of operation sacrifices very little in performance, but permits a substantial reduction in the throat heat flux. Author

N63-14313 Aro, Inc., Arnold Air Force Station, Tenn.
SIMULATION OF HIGH TEMPERATURE AIR FOR AERODYNAMIC AND HEAT TRANSFER TEST PURPOSES
K. E. Tempelmeyer, M. H. Nesbitt, and J. E. Shepard Arnold Engineering Development Center, Mar. 1962 49 p 16 refs
(Contract AF 40(600)-800; S/A 24(61-73))
(AEDC-TDR-62-40)

A method to simulate a gaseous test medium for aerodynamic and heat-transfer-test purposes is proposed. The solution of a set of simultaneous equations is employed to specify a gas mixture which has the same macroscopic thermal and transport properties as some other gas or mixture. Experimental tests to determine the effectiveness of this gas-simulation theory are also described. The addition of small amounts of argon, helium, and oxygen to a hydrocarbon combustion gas resulted in a new gas mixture which produced the same heat-transfer and friction coefficients as air heated to the same temperature. A combustion-gas test medium alone, however, exhibited different heat-transfer characteristics from those of air. Thus, it appears possible to avoid the use of some impractical test medium for certain test purposes by replacing it with a more convenient mixture of gases. Author

N63-14382 University of Southern Calif. Engineering Center, Los Angeles
NOZZLE FLOW AT LOW REYNOLDS NUMBERS [Summary Report]
J. G. Everton *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 18-24 refs (See N63-14379 10-11)

The history of nozzle calibration in the low density wind tunnel is reviewed. The best method of measuring flow conditions in such tunnels is by probing the flow upstream to a point as close to the throat as possible, and by making sure there are no shocks or compression zones and that there is a flat core profile. Calculation of the local static pressure from the local impact pressure and the reservoir pressure is found to be feasible and usable. Impact pressure profiles are given. D.E.R.

N63-14383 University of Southern Calif. Engineering Center, Los Angeles
ORIFICE FLOW AT LOW REYNOLDS NUMBERS [Summary Report]
F. O. Smetana *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 24-30 refs (See N63-14379 10-11)

The calculation of the density level at which a particular nozzle will completely fill with viscous flow is studied. The purpose is to design low density nozzles that will avoid excessive boundary layer growths and still create flows that can be accelerated to supersonic velocities without separation and viscous fill-up. The data available does not permit the design to be fully evaluated, but recommendations for further study based on the departure from the isentropic core flow at higher Reynolds numbers and the approach of behavior characteristics typical of Hagen-Poiseuille flow are made. D.E.R.

N63-14409 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Mulheim an der Ruhr (W. Germany)
EXPERIMENTELLE UNTERSUCHUNGEN DES STABILITÄTSVERHALTENS VON DÜNWANDIGEN KEGELSCHALEN UNTER AXIALLAST UND INNENDRUCK [EXPERIMENTAL INVESTIGATIONS OF THE STABILITY BEHAVIOR OF THIN-WALLED CONICAL SHELLS UNDER AXIAL LOAD AND INSIDE PRESSURE]
Walter Schnell and Klaus Schiffner Nov. 1962 61 p 5 refs In German
(DVL-243)

Stability investigations were conducted on conical and cylindrical thin-walled mylar shells under axial load and internal pressure. The series of experiments included shells with a half aperture angle of 0.0° to 30° for various wall thicknesses. Results of buckling loads, postbuckling behavior, and buckling shapes are discussed.
Trans. by I.v.L.

N63-14410 Massachusetts Inst. of Tech. Fluid Dynamics Research Lab., Cambridge
EXPERIMENTS ON CYLINDER DRAG, SPHERE DRAG AND STABILITY IN RECTILINEAR COUETTE FLOW
David L. Kohlman Mar. 1963 160 p 51 refs
(AF Grants AFOSR-62-187 and AFOSR-156-63)
(MIT Fluid Dynamics Res. Lab. Rept. 63-1)

The purpose of this study was to develop an apparatus for investigation of phenomena in rectilinear Couette flow, and to conduct experiments in several such areas. The limited validity of Lamb's drag law for circular cylinders in a finite channel is demonstrated. As the Reynolds number decreases, the walls cause a transition from Oseen flow to Stokes flow. Empirical drag formulas are presented. Stokes formula for sphere drag in uniform flow is shown also to be valid in uniform shear flow. Measurements of sphere rotation rates in shear flow are presented. Stability studies indicate that rectilinear Couette flow becomes unstable in the range $10^3 < Re_s < 10^4$. The primary disturbance is a series of vortices midway between the walls whose wavelength decreases with increasing Re_s. The practical foundation is laid for further study and experimentation in this area. Author

N63-14427 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REAL-GAS EFFECTS ON HYPERSONIC NOZZLE CONTOURS WITH A METHOD OF CALCULATION
Charles B. Johnson, Lillian R. Boney, James C. Ellison, and Wayne D. Erickson Washington, NASA, Apr. 1963 53 p 16 refs
(NASA TN D-1622) OTS: $1.50

A method is presented for computing the wall coordinates of a hypersonic nozzle with real-gas effects. Results of calculations at a Mach number of 17 for stagnation temperatures and pressures up to 5,000° R and 1,000 atmospheres are presented. A procedure for calculating both the inviscid contour and boundary-layer displacement thickness is presented along with a complete computer program written in FORTRAN language. Calculations are presented for a Mach-number-17 nozzle for nitrogen at various stagnation conditions to indicate the difference between the use of real-gas properties and the ideal gas with constant heat-capacity ratio. The effect of stagnation conditions on both the inviscid flow field and the growth of the displacement thickness has been investigated. Whereas the present results were obtained for nitrogen, the method of calculation presented could be applied to other gases with only slight modification. Author

N63-14588 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN INVESTIGATION OF FLOW VISUALIZATION TECHNIQUES IN HELIUM AT MACH NUMBERS OF 15 AND 20

Charles E. Duller Washington, NASA, Apr. 1963 18 p 8 refs
(NASA TN D-1769) OTS: $0.50

This report presents an investigation which adapted the techniques developed for subsonic and supersonic flow visualization to a helium tunnel operating at Mach numbers of 15 and 20. Three techniques are discussed: (1) the fluorescent-oil film technique for making surface streamlines visible and for locating flow separation on a test body; (2) the white-lead technique for locating the stagnation point and streamlines radiating from the stagnation point on a test-body face at various angles-of-attack; and (3) the ionization technique for making visible the regions of flow separation and attachment on afterbodies. Results indicate that surface streamlines, stagnation points, and separated and attached flow over an afterbody may be made visible on a variety of test-body configurations in hypervelocity helium flow. Author

N63-14589 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED WIND-TUNNEL INVESTIGATION OF AN ANNULAR-JET CONFIGURATION IN GROUND PROXIMITY

James H. Otis, Jr., and Kenneth W. Goodson Washington, NASA, Apr. 1963 47 p 6 refs
(NASA TN D-1779) OTS: $1.25

An investigation to determine the ground-effect characteristics of a 42-inch-diameter annular-jet model, at forward speeds up to 100 feet per second, has been conducted in the 17-foot test section of the Langley 300-MPH 7- by 10-foot tunnel. Results indicated that at zero angle-of-attack a rapid increase in lift augmentation was obtained with forward speed, and this variation was relatively independent of the height-diameter ratio. Relatively large drag forces, of which the inlet momentum drag was a predominant factor, were measured at the higher velocity ratios. At the low height-diameter ratios and low velocity ratios, however, the total measured drag was less than the calculated inlet momentum drag. At the low velocity ratios, the rate of increase of the pitching-moment parameter, with respect to velocity ratio, decreased as the ground was approached. Author

N63-14607 Tennessee U., Knoxville

ANALYTICAL STUDIES ON NOZZLE THROAT COOLING

P. F. Pasqua, P. N. Stevens, J. E. Mott, H. C. Roland, and J. C. Robinson Arnold Engineering Development Center, Apr. 1963 162 p 20 refs
(Contract AF 49(600)-981)
(AEDC-TDR-63-58)

Analytical studies have been made concerning many of the problems associated with the expansion of extremely high temperature and pressure plasmas through the converging section of a hypersonic wind-tunnel nozzle. The problems in this study relate to the establishment of heat fluxes to the nozzle wall; methods of removing the heat load or protecting the nozzle wall; determining the stress levels in the nozzle liner; and analyzing various materials for strength and thermal properties. In all cases, parametric studies have been made resulting in design criteria which can be used for specific conditions. The conditions are established from the performance envelope for a typical low-density hypersonic wind tunnel. Throughout the report, the performance envelope is plotted on stagnation pressure and temperature coordinates which correspond to free-stream velocities and altitudes up to 25 kilofeet/sec and 350 kilofeet, respectively. Author

N63-14680 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

EFFECTS OF EXTERNAL STREAM ON THE PERFORMANCE OF ISENTROPIC PLUG-TYPE NOZZLES AT MACH NUMBERS OF 2.0, 1.8, AND 1.5

Alfred S. Valerino, Robert F. Zappa, and Kaleel L. Abdalla Washington, NASA, Mar. 1959 43 p 6 refs
(NASA MEMO 2-17-59E) OTS: $1.25 (Declassified)

An investigation of the external stream effects on the performance characteristics of several isentropic-plug exhaust nozzles was conducted in the NASA Lewis 8- by 6-foot supersonic tunnel at zero angle-of-attack, through a jet-pressure-ratio range from jet-off to approximately 25 at free-stream Mach numbers of 2.0, 1.8, and 1.5. The variables investigated included nozzle-design pressure ratio, ratio of nozzle-throat to maximum body area, and afterbody shape. In addition, the effects of partial internal expansion and of ring-shaped afterbody extensions were studied for a nozzle designed to operate at a pressure ratio of 25. For nozzles operating at pressure ratios lower than design, low base pressures resulting from the interaction of the jet with a supersonic stream have large adverse effects on thrust. Overall performance is improved by increasing the base size to permit more reasonable boattail angles. Improved overall performance may also be obtained by the incorporation of some internal expansion or by the addition of ring-shaped afterbody extensions to improve the external flow. As a result of the adverse jet-stream-interaction effects, thrusts predicted from quiescent-air nozzle data become increasingly optimistic as the design pressure ratio increases. Magnitudes of stream effects on thrust for a Mach 3 design nozzle are 9 percent at Mach 1.5 and 3 percent at Mach 2.0. Author

N63-14681 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL INVESTIGATION OF A DISK-SHAPED REENTRY CONFIGURATION AT TRANSONIC AND LOW SUPERSONIC SPEEDS

Frank A. Lazzeroni Washington, NASA, May 1962 27 p 10 refs
(NASA TM X-652) OTS: $2.60 ph, $1.01 mf (Declassified)

An investigation has been made to determine the static longitudinal and lateral-directional aerodynamic characteristics of a disk-shaped reentry configuration. The model had an elliptic profile with a maximum thickness-diameter ratio of 0.325. The tests were conducted to maximum angles of attack and sideslip of 22°, over a Mach number range from 0.95 to 1.50, at a Reynolds number of 3.5×10^6. The basic disk was longitudinally unstable about a center of gravity at 40 percent of the diameter from the leading edge. Addition of a canopy, vertical stabilizing surfaces, and horizontal control surfaces provided static longitudinal and directional stability through the angle-of-attack range at Mach numbers above 1.0. At a Mach number of 0.95, a slight pitch-up occurred at angles of attack above 5°. Author

N63-14682 National Aeronautics and Space Administration. Langley Research Center, Langley Air Force Base, Va.

INVESTIGATION OF THE LOW-SUBSONIC STABILITY AND CONTROL CHARACTERISTICS OF A 0.34-SCALE FREE-FLYING MODEL OF A MODIFIED HALF-CONE REENTRY VEHICLE

James L. Hassell, Jr. and George M. Ware Washington, NASA, Jan. 1962 42 p 7 refs
(NASA TM X-665) OTS: $4.60 ph, $1.46 mf (Declassified)

An investigation of the low-subsonic stability and control characteristics of a 0.34-scale free-flying model of a modified half-cone reentry vehicle having a 13° blunted semiapex angle has been made in the Langley full-scale tunnel. The longitudinal stability characteristics were considered to be satisfactory for all except the highest angle-of-attack flight conditions covered in the test program. At angles-of-attack between about 27° and 36°, the stability varied from neutral to slightly unstable. Improved stability was obtained at these higher angles either by increasing the span of the horizontal tails

or by increasing the area of the trimmer flaps. The lateral stability characteristics were generally satisfactory up to an angle-of-attack of about 24°. At higher angles-of-attack, there was a lightly damped Dutch-roll oscillation. A simple roll damper caused the Dutch-roll oscillation to become very well damped at all test angles-of-attack. Satisfactory longitudinal and lateral control characteristics were obtained at low and moderate angles-of-attack when both the basic horizontal tails and trimmer flaps were used together for control and when the lateral control system included a jet-reaction yaw control. The yaw control was found necessary to balance out the adverse yawing moments of the roll control system. At higher angles-of-attack, increased control surface area was required for satisfactory control characteristics. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-14252 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRESSURE DISTRIBUTIONS ON THREE RIGID WINGS SIMULATING PARAWINGS WITH VARIED CANOPY CURVATURE AND LEADING-EDGE SWEEP AT MACH NUMBERS FROM 2.29 TO 4.65

Paul G. Fournier Washington, NASA, Apr. 1963 112 p 10 refs (NASA TN D-1618) OTS: $2.50

An investigation has been made at Mach numbers from 2.29 to 4.65 in the Langley Unitary Plan wind tunnel to determine the chordwise pressure distribution at supersonic speeds of three parawing models through an angle-of-attack range from 0° to 70°. Three rigid metal models simulated a parawing which had a basic flat planform with leading edges swept back 45°. These configurations were developed to have one-half-circle, one-third-circle, and one-quarter-circle curvature of the semispan trailing edges when viewed from downstream and resulting leading-edge sweeps of 61.5°, 52.5°, and 48.6°. The results of the investigation are presented as curves of chordwise pressure distributions at four spanwise locations for each model. Author

N63-14437 Bundesministerium für Verkehr, Bonn (W. Germany)

UNTERSUCHUNGEN AN BLASFLÜGELN [JET FLAP INVESTIGATIONS]

K. Kraemer (Aerodynamische Versuchsanstalt, Göttingen) Dusseldorf, VDI-Verlag GmbH, 1962 34 p 18 refs In German (*Its* Luftfahrt-Forschungsberichte 13)

In order to investigate more thoroughly the basic behavior of wings where blowout occurs from a slot near the trailing edge, power measurements were made on jet flaps, and the results were compared with theory. Investigations were conducted on: (1) a circular cylinder of large aspect ratio with strong variations in the blowing direction (up to 145°); (2) the same cylinder with boundary-layer influence for the suppression of flow separation at the rear side of the cylinder; and (3) a rectangular wing with aspect ratio $\lambda = 5$, symmetrical profile, and trailing-edge blowing at various angles (0.0°, 45°, 90°). For nondimensional representations, generalized aerodynamic values were introduced. These values remain the same under arbitrary blowout strength. The measurements show that a component exists which is not accounted for by theory, namely, the impulse current loss of the jet, caused by jet deflection. Trans. by I.v.L.

N63-14439 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Aerodynamik, Brunswick, (W. Germany)

UNTERSUCHUNGEN ÜBER DIE AUFTRIEBSERHÖHUNG EINES TRAGFLÜGELS BEI GLEICHZEITIGEM AUSBLASEN AN DER HINTERKANTENKLAPPE UND AN DER PROFILNASE [CALCULATIONS ON THE LIFT GAIN OF AN AIRFOIL WITH SIMULTANEOUS BLOWING ON THE TRAILING EDGE AND THE NOSE PROFILE]

K. Gersten and R. Löhr Sept. 7, 1962 32 p 16 refs In German Presented at the 5th European Cong. of Aeronautics, Venice, Sept. 12-15, 1962

(DFL-189) DFL: DM 8.50

Investigations of an airfoil with simultaneous blowing on the trailing edge and profile nose are reviewed. The impulse coefficients can be varied independently. The maximum total impulse coefficient is $c_\mu G = 2$. Additional blowing on the nose, at a constant lift coefficient, produces smaller moments of nose heaviness. Impulse coefficients, which are exactly necessary in avoiding boundary-layer separation, are estimated analytically. In the area of supercirculation, an optimum impulse distribution exists. Blowing on the nose profile can, under certain conditions, result in a gain in lift for a wing near the ground. Trans. by I.v.L.

N63-14440 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Aerodynamik, Brunswick (W. Germany)

AERODYNAMIC PROBLEMS OF HIGH LIFT

H. Schlichting Oct. 1962 53 p 52 refs Transl. by W. Pechau Presented at the Third Intern. Cong. in the Aeronaut. Sci., Stockholm, Sweden, Aug. 27-Sept. 1, 1962

(DFL-190; Rept. 62/25, Schl/Be.) Available from DFL: DM 13.50

A comprehensive survey is given on the results of investigations into the aerodynamic problems of high lift of airfoils, which have been performed in the Deutsche Forschungsanstalt für Luft- und Raumfahrt Braunschweig and in the Aerodynamische Versuchsanstalt Göttingen in the last few years. Author

N63-14442 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Aerodynamik, Brunswick (W. Germany)

EINIGE UNTERSUCHUNGEN AN NASENKLAPPENFLÜGELN KLEINER STRECKUNG MIT UND OHNE RUMPF [SOME CALCULATIONS ON LOW ASPECT RATIO WINGS WITH LEADING EDGE FLAPS—WITH OR WITHOUT FUSELAGE]

F. Thomas Nov. 13, 1962 32 p 28 refs In German

(DFL-191) DFL: DM 10.50

Wind tunnel measurements are presented for three wings (profile NACA 0005) with aspect ratio $\lambda = 2$ and angles of sweepback $\phi = 0.0°; 33.7°; 57.3°$. Rectangular, sweptback, and delta wings were investigated. These wings had leading-edge flaps spaced lengthwise the wingspread. The flaps affected an increase in lift only at a 33.7° angle of sweepback. A comparison made between these experimental results and the Truckenbrodt lifting surface theory showed a good correlation for the pitching moment but a poor correlation for lift. Trans. by I.v.L.

N63-14531 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Flugmechanik, Brunswick (W. Germany)

LUFTDURCHLÄSSIGKEIT UND ELASTISCHE EIGENSCHAFTEN VON FALLSCHIRMGEWEBEN ERGEBNISSE EINER REIHENUNTERSUCHUNG [AIR PERMEABILITY AND ELASTIC CHARACTERISTICS OF PARACHUTES: RESULTS OF MANY INVESTIGATIONS]

H.-D. Melzing Apr. 12, 1962 82 p 12 refs In German
(DFL-159)

Twenty-six different textures of various parachute fabrics were investigated. Results indicated the air permeability and the camber to be a function of the pressure differential. From these results, the degree of fatigue and the recovery capability of a given texture can be determined. Furthermore, the resistance and air permeability values are shown to be a function of the Reynolds number. Empirical formulas for calculating the air permeability at arbitrary pressure differentials are presented. Results are compared with measurements made by Schopper and von Mickelwright testing instruments. A new investigation of the effective porosity by H. G. Heinrich is presented. Trans. by I.v.L.

N63-14662 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Inst. für Triebwerk-Mechanik, Aachen (W. Germany)

ZUR DYNAMIC VON LUFTSCHRAUBEN-FERNANTRIEBEN [ON THE DYNAMICS OF PROPELLER REMOTE DRIVES]

W. Pinnekamp Feb. 1963 64 p 7 refs In German
(DVL-197) Available from Vereinigte Universitäts- u. Fachbuchhandlungen, R. -Wagner-Str. 1, Cologne, W. Germany

The application of remote drive, for bringing the spatial separation of motor and propeller, requires, along with reliable control of bending vibrations, the solution to problems of torsional vibrations. First of all it is shown that, as a rule, it is not possible to have a dangerous ignition critical speed of rotation which is above the normal speed range. The one solution is to lower the characteristic frequency in such a manner that resonances occur only at speeds lower than the idling speed. The range of these resonances will have been transversed at the very start of the drive mechanism. A method is presented for calculating those vibration effects which occur. Comparative theoretical investigations lead to general criteria for the optimal dynamic design of a remote drive. This design, which includes a flywheel and properly proportioned couplings, keeps the requirements of the propeller and the degree of motor irregularity within reasonable limits. Results of measurements are presented which indicate the reliability of the theory. Trans. by I.v.L.

N63-14687 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

AERODYNAMICS OF TILTING DUCTED-FAN CONFIGURATIONS

Paul F. Yaggy (Ames Res. Center) and Kenneth W. Goodson *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 49-63 2 refs (See N63-14683 10-04)

Tests of a full-scale ducted fan have been made at the Ames Research Center. The results of these studies have indicated that the concept of wing-tip-mounted ducted fans has longitudinal problems similar to other V/STOL concepts; however, solution of these problems appears to be possible. An advantage of this concept is the ability to vary the thrust vector independent of the wing angle-of-attack. Thus, it is possible to keep the wing unstalled, even in descending flight. Author

N63-14689 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

INDUCED INTERFERENCE EFFECTS ON JET AND BURIED-FAN VTOL CONFIGURATIONS IN TRANSITION

Kenneth P. Spreemann *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 79-85 3 refs (See N63-14683 10-04)

Recent investigations of some jet and buried-fan configurations have indicated that, in the transition speed range, configurations with considerable area surrounding the jet or buried fan can encounter large losses in lift and nose-up pitching moments, due to the pressures induced on the lower surfaces by the interaction of the jet and free-stream flow. The obvious way of minimizing these effects is to reduce the surface area surrounding the jets or buried fans, that is, to consider these effects in the preliminary stages of the airplane design. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-14247 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STABILITY AND CONTROL CHARACTERISTICS OF A 0.0667-SCALE MODEL OF THE FINAL VERSION OF THE NORTH AMERICAN X-15 RESEARCH AIRPLANE (CONFIGURATION 3) AT TRANSONIC SPEEDS

Robert S. Osborne Washington, NASA, Apr. 1963 103 p 10 refs
(NASA TM-X-758) OTS: $2.50

In order to determine its static longitudinal- and lateral-directional stability and control characteristics at transonic speeds, a 0.0667-scale force model of configuration 3 of the North American X-15 research airplane has been tested in the Langley 8-foot transonic pressure tunnel. The test range included Mach numbers from 0.60 to 1.18, angles-of-attack from -20° to 20°, and angles-of-sideslip of -5.1° and 0°. The results of the investigation, including a summary of some of the important stability and control parameters, are presented without analysis. Author

N63-14297 R. F. D., Ltd., Godalming (Gt. Brit.)

SAFETY IN OVER-WATER FLIGHTS. A STUDY OF TEN YEARS LOSSES OF AIRCRAFT OVER WATER, JANUARY, 1952—DECEMBER, 1962

B. W. Townshend Mar. 1963 37 p 1 ref

An attempt is made to present an independent and unbiased survey of all aircraft losses over water which have occurred in recent years. The period selected is of course entirely arbitrary, but is useful insofar as it covers obsolescent piston-engined propeller-driven types and more modern jets, where these have been involved. Author

N63-14307 ARINC Research Corp., Washington, D.C.

PREDICTION OF FIELD RELIABILITY FOR AIRBORNE ELECTRONIC SYSTEMS

H. Balaban and A. Drummond Dec. 31, 1962 74 p refs
(Contract AF 33(657)-7382)
(*Its* Publ. 203-1-344)

The purpose of this report is to update the basic part malfunction data presented in Aeronautical Radio Inc. research publication, "Improved Techniques for Design-Stage Prediction," published in 1959, and to present an improved prediction procedure which has been developed recently. This procedure is based on using observed part malfunction data to predict both a point estimate and a confidence interval estimate of a new system's malfunction rate. The predicted system malfunction rate is used in conjunction with expected

maintenance parameters to predict a point estimate and corresponding approximate confidence interval for steady-state probability of no-system complaint and probability of satisfactory operation. The procedure is discussed in general terms. A step-by-step program for implementing the procedure is presented. Detailed discussions of various point and derivations of formulas are presented in appendices. I.v.L.

N63-14353 Deutsche Forschungsanstalt für Luftfahrt. Inst. für Aerodynamik, Brunswick (W. Germany)
AERODYNAMISCHE PROBLEME DER FLUGZEUGE BEI START UND LANDUNG [AERODYNAMIC PROBLEMS AT TAKE-OFF AND LANDING]
H. Schlichting Sept. 2, 1962 30 p 22 refs In German Presented at the Conf. of the Aeronautics Res. Committee of the Aeron. Board of Traffic Directors League, Düsseldorf, Oct. 25, 1962
(Rept. 62/41, Schl./Be; DFL-193)

The development of high-speed airplanes during the last twenty years has caused increasing difficulty in takeoff and landing due to the high speeds involved in each case. Aerodynamic problems, such as shortening of runways and the means of increasing maximum lift, are discussed. Illustrations are presented of the aerodynamic problems of extremely short takeoff and landing airplanes that have been developed within the last ten years. Results of research on maximum lift, conducted at the Institute for German Airplane Aerodynamics in Braunschweig and at the Aerodynamic Research Institute in Goettingen over the last ten years, are presented. Trans. by I.v.L.

N63-14366 Boeing Co. Vertol Div., Morton, Pa.
RESEARCH PROGRAM TO DETERMINE THE FEASIBILITY AND POTENTIAL OF THE GROUND EFFECT TAKE-OFF AND LANDING (GETOL) CONFIGURATION, VOLUME II [Final Summary Report, Sept. 29, 1960 to Mar. 28, 1962]
H. Wahl, F. Mc Hugh, R. Hooper, and W. Stepniewski Ft. Eustis, Va., Army Transportation Research Command, Dec. 1962 202 p 6 refs For Vol. II see N63-14367 10-04
(Contract DA-44-177-TC-663)
(TCREC-62-63; R-276)

This final report has been prepared as Volume I and Volume II to describe the effort expended to determine the feasibility and potential of the Ground Effect Take-Off and Landing (GETOL) configuration. The object of such an aircraft is to combine relatively high cruising speeds with the capability of operating from any flat surface (unprepared fields, water, snow, etc.). The main part of testing was performed by NASA at their Langley Field facilities, in the static room, tow track, and wind tunnel. Princeton and Toronto Universities also contributed data as the result of their development testing effort. NASA test results were utilized as the basic information. Analytical methods for data reduction and presentation were developed, thus permitting evaluation of the performance, stability, and control characteristics of the GETOL type aircraft. The results of the whole GETOL program provided a basis for a subsequent design analysis and layouts of the Flight Research Vehicle (FRV). Acquisition of basic GETOL aerodynamic data and development of a method of analysis and data presentation should be considered as the most significant technical advances achieved under this program. Author

N63-14367 Boeing Co. Vertol Div., Morton, Pa.
RESEARCH PROGRAM TO DETERMINE THE FEASIBILITY AND POTENTIAL OF THE GROUND EFFECT TAKE-OFF AND LANDING (GETOL) CONFIGURATION, Vol. II [Final Summary Report, Sept. 29, 1960 to March 28, 1962]
H. Wahl, F. Mc Hugh, R. Hooper, and W. Stepniewski Ft. Eustis, Va., Army Transportation Research Command, Dec. 1962 199 p 101 refs For Vol. I and abstract see N63-14366 10-04
(Contract DA-44-177-TC-663)
(TCREC-62-63; R-276)

N63-14429 National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
PRELIMINARY FLIGHT EVALUATION OF TWO UNPOWERED MANNED PARAGLIDERS
Garrison P. Layton, Jr., and Milton O. Thompson Washington, NASA, Apr. 1963 33 p 4 refs
(NASA TN D-1826) OTS: $1.00

Towed and free-flight tests were made with unpowered, manned paragliders to study the performance, stability, and control characteristics of a typical paraglider. The paragliders used had maximum lift-drag ratios greater than 3.5, and wing loadings of approximately 4.0 lb/sq ft. The airspeed range was limited by the rearward center-of-pressure shift at angles-of-attack above and below trim angle-of-attack. Performance data obtained from flight tests are presented and compared with analytical results. Center-of-gravity shift, accomplished by tilting the wing relative to the fuselage, was used for control. This method of control was adequate for towed and free flight as well as for flare and landing. The pilot's evaluation of the vehicle's handling qualities, and a discussion of development problems are presented. Author

N63-14438 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Flugmechanik, Brunswick (W. Germany)
DER EINFLUSS VON SCHNEEMATSCH AUF DIE STARTSTRECKEN VON FLUGZEUGEN [THE INFLUENCE OF SLUSH ON THE TAKE-OFF RUN OF AN AIRPLANE]
H. Herb Sept. 12, 1962 24 p 13 refs In German
(DFL-188) DFL: DM 9,20

This review presents a survey of the investigations, carried out abroad, of the influence of slush on the lengthening of the takeoff run of an airplane. An evaluation of the results of these measurements leads to specific coefficients of friction for takeoff calculations under slush conditions. Unfortunately, these measurements indicate that general valid results for jet hindrance cannot be reached even by means of expensive research. This is due to the fact that the influence of slush on the takeoff run is strongly dependent upon the geometry of the airplane, i.e., design and shape of the landing gear, engine, position of the wings, etc. Trans. by I.v.L.

N63-14527 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Calif.
STABILITY CHARACTERISTICS FROM MACH NUMBER 1.0 TO 3.2 OF A MISSILE OF FINENESS RATIO 11.5 WITH A 10° FLARED-SKIRT AFTERBODY
Hal T. Baber, Jr., and Allen B. Henning Washington, NASA, Mar. 1959 36 p 11 refs
(NASA MEMO 4-2-59L) OTS: $3.60 ph, $1.28 mf (Declassified)

A rocket-propelled missile has been test-flown by the Langley Pilotless Aircraft Research Division in order to study the stability characteristics of a conical-flare-stabilized body. The stabilizing flare had a 10° flare angle, a flare length-to-body diameter ratio of 1.42, and a base-to-body diameter ratio of 1.50. The body of overall fineness ratio 11.5 had a nose of fineness ratio 3.5 and a cylindrical midsection. The missile was disturbed in flight by pulse rockets to produce transient responses which were required in order to obtain stability data. The test was performed over a Mach number range of 1.0 to 3.2 and a Reynolds number range of 2.4×10^6 to 17.4×10^6 per foot. Induced-roll effects were noted at the higher test Mach numbers when the configuration experienced a high resultant angle-of-attack. The normal-force-curve slope was essentially constant with Mach number and was of the order of 0.07 per degree for small angles-of-attack. The aerodynamic-center location varied between 48 and 59 percent of the body length over the Mach-number range. The damping of the oscillatory mode of motion was low. Author

N63-14613 Federal Aviation Agency. Systems Research and Development Service, Washington, D.C.
NORTH ATLANTIC REGION AIR TRAFFIC SURVEY, FY 1962 Final Report
Richard M. Warfield Mar. 1963 135 p

This report summarizes the traffic data collected in the North Atlantic Region Traffic Survey during FY 1962. Monthly peak-day flight-plan data were collected from 12 participating Oceanic Area Control Centers by the Federal Aviation Agency. Instantaneous airborne-aircraft counts (IAC) were calculated at the beginning of each hour during the monthly peak days. A peak IAC of 94 aircraft occurred at 0500Z on September 10, 1961. Author

N63-14618 Federal Aviation Agency. Systems Research and Development Service, Washington, D.C.

MILITARY CROSS-COUNTRY FLIGHT ACTIVITY. TYPICAL BUSY DAY Memorandum Report

Richard G. Brown Feb. 1963 47 p

This report was prepared from flight plans submitted for three peak days in Fiscal Year 1961, by the Military Flight Service Centers. The information presented describes military cross-country flight activity in the continental United States on a typical busy day.

Author

N63-14683 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

NASA CONFERENCE ON V/STOL AIRCRAFT A Compilation of the Papers Presented [at] Langley Research Center, Langley Field, Va., Nov. 17-18, 1960

[1960] 241 p 86 refs

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26. SUMMARY OF THE V/STOL STATE OF THE ART C. H. Zimmerman (NASA. Langley Research Center) p 335-345 (See N63-14709 10-04)

N63-14684 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

REVIEW OF BASIC PRINCIPLES OF V/STOL AERODYNAMICS

Richard E. Kuhn *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 1-17 4 refs (See N63-14683 10-04)

This paper reviews the principal factors that determine the performance of V/STOL aircraft. These can be summarized as follows: In hovering, the power required, the fuel consumption, and the downwash dynamic pressure are all determined by and increase with increasing slipstream area loading. In transition, the wing span, the distribution of load on that span, and the power required in hovering determine the shape of the power-required curve, and through this, the engine-out safety and STOL performance. In cruise, some compromises are required but, generally, the same rules for designing good cruise performance into conventional airplanes still

apply to V/STOL configurations, namely, attention to aerodynamic cleanliness to reduce the parasite power and a wing of appreciable span to reduce the induced power. Author

N63-14685 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

AERODYNAMIC CHARACTERISTICS OF PROPELLER-DRIVEN VTOL AIRCRAFT

Robert H. Kirby *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 19-34 8 refs (See N63-14683 10-04)

This paper discusses the two major configurations that are usually considered for achieving VTOL while keeping the fuselage essentially horizontal—that is, the tilt-wing and the deflected-slipstream configurations. Because of the high turning losses incurred by deflected-slipstream configurations in hovering, and because of the wing-stalling problem of the pure tilt-wing configurations during the transition, it appears that a combination of the two principles should be used. This tilt-wing and flap configuration should make use of a programed extensible-chord slotted flap, together with a leading-edge high-lift device, in order to avoid the performance and handling qualities problems associated with wing stalling during the transition while keeping the wing area as low as possible for efficiency in cruising flight. Author

N63-14686 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LARGE-SCALE WIND-TUNNEL STUDIES OF SEVERAL VTOL TYPES

Mark W. Kelly *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 35-48 3 refs (See N63-14683 10-04)

The results of full-scale wind-tunnel investigations of VTOL aircraft are discussed to define those problem areas in which further research is required. The categories of VTOL aircraft tested include: (1) those using lightly loaded helicopter-type rotors, (2) those using moderately loaded airplane-type propellers, and (3) those using highly loaded ducted fans or lifting engines. The problem areas encountered are: (1) loss of propulsive efficiency during cruise flight, regardless of disk loading; (2) inability of tilt-wing aircraft to make steep descents or to decelerate without wing stall; and (3) the drag and pitching moment of ducted-fan configurations result in serious power and control problems during transition flight. R.C.M.

N63-14688 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMICS OF A FAN-IN-FUSELAGE MODEL

Ralph L. Maki and David H. Hickey *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 65-77 (See N63-14683 10-04)

Wind-tunnel tests have been carried out on a large-scale complete-model VTOL aircraft in the Ames 40- by 80-foot wind tunnel. An unswept wing having an aspect ratio of 5, a taper ratio of 0.5, and 10-percent-thick sections was used. Wing incidence was 0° and the fan-to-wing area ratio was 8 percent. The fan was housed in the fuselage and was driven by the exhaust gases from a General Electric prototype J85 engine. The design disk loading of the fan was about 350 lb/sq ft. From consideration of 1 g steady-flight conditions derived from wind-tunnel data, these conclusions are drawn: (1) a variety of transition flight plans are possible; (2) angle of attack must be varied to provide a smooth transition; (3) lift-force vectoring must be supplemented by some direct thrust during transition flight to eliminate discontinuous attitude and trim changes; and (4) all trim controls should be programed linked to a single pilot cockpit control. R.C.M.

N63-14690 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

GROUND INTERFERENCE EFFECTS

Robert O. Schade *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 87-100 (See N63-14683 10-04)

A study has been made to determine the basic phenomena associated with the ground interference effects for VTOL aircraft, in an attempt to arrive at some generalized conclusions regarding the effect of the ground on the various types of VTOL aircraft. The results showed that helicopter and other rotor aircraft generally experience favorable ground effect. In the case of propeller VTOL aircraft, the tilt-wing configurations will usually experience a small, favorable ground effect. For the deflected-slipstream configurations, a large detrimental ground effect is experienced at low angles-of-attack of the thrust axis but little or no ground effect at angles-of attack of 25° or 30°. For buried-fan and jet configurations, the ground effect can be favorable or unfavorable depending upon the geometry of the fans or jets and the airframe. For single-jet configurations, the ground effects are detrimental and cannot be eliminated by fixes on the airplane. For these cases, a perforated landing platform appears to offer promise as a means of minimizing the adverse ground effect. Ground effects experienced in hovering flight tend to decrease with increasing forward speed, and are rather small at airspeeds that might be of interest for STOL operation of the various VTOL configurations. Author

N63-14691 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

CONSIDERATIONS OF METHODS OF IMPROVING HELICOPTER EFFICIENCY

Richard C. Dingeldein *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 101-117 23 refs (See N63-14683 10-04)

Recent NASA helicopter research indicates that significant improvements in hovering efficiency, up to 7 percent, are available from the use of the NACA 63A015(230) airfoil section. This airfoil should be considered for flying-crane-type helicopters. Application of standard leading-edge roughness causes a large drop in efficiency; however, the cambered rotor is shown to retain its superiority over a rotor having a symmetrical airfoil when both rotors have leading-edge roughness. A simple analysis of available rotor static-thrust data indicates a greatly reduced effect of compressibility effects on the rotor profile-drag power than predicted from calculations. Preliminary results of an experimental study of helicopter parasite drag indicate the practicability of achieving an equivalent flat-plate parasite-drag area of less than 4 square feet for a rotor-head—pylon—fuselage configuration (landing gear retracted) in the 2,000-pound minimum-flying-weight class. The large drag penalty of a conventional skid-type landing (3.6 square feet) can be reduced by two-thirds by careful design. Clean, fair, and smooth fuselages that tend to have narrow, deep cross sections are shown to have advantages from the standpoint of drag and download. A ferry range of the order of 1,500 miles is indicated to be practicable for the small helicopter considered. Author

N63-14692 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

OPERATIONAL TECHNIQUE FOR TRANSITION OF SEVERAL TYPES OF V/STOL AIRCRAFT

Fred J. Drinkwater III *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 119-129 (See N63-14683 10-04)

Flight experiences of the transition capabilities of five representative types of V/STOL aircraft are discussed. The significant feature of all aircraft tested was their ability to change the direction of engine-produced thrust from horizontal in order to provide thrust

for forward flight. These aircraft are the Vertol VZ-2, Ryan VZ-3, Doak VZ-4, Bell XV-3, and Bell X-14. The conclusions drawn from these experiences include the following: a test program should consider the effects of large deviations from the fuselage level trim speeds at partial conversion angles; if a constant-power flare cannot be made, the power control should be actuated in a manner similar to a helicopter collective-pitch control; and the V/STOL aircraft must be capable of developing 1.2 g for flare with the most critical engine out at its minimum acceptable approach speed. R.C.M.

N63-14693 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

HANDLING QUALITIES EXPERIENCE WITH SEVERAL VTOL RESEARCH AIRCRAFT

John P. Reeder *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va. Nov. 17-18, 1960 p 131-147 1 ref (See N63-14683 10-04)

All of the VTOL research aircraft discussed in this paper have successfully demonstrated conversion from hovering to airplane flight and vice versa. However, control about one or more axes of these aircraft has been inadequate in hovering flight. Furthermore, ground interference effects have been severe in some cases and have accentuated the inadequacy of control in hovering and very-low-speed flight. Stalling of wing surfaces has resulted in limitation in slowdown and descending flight, particularly for the tilt-wing aircraft, which is a very rudimentary type. Minor modifications to the wing leading edge in this case have, however, produced surprisingly large and encouraging reductions in adverse stall effects. Height control in hovering and in low-speed flight has proved to be a problem for the aircraft not having direct control of the pitch of the rotors. The other systems have shown undesirable time lags in development of a thrust change. Author

N63-14694 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

AERODYNAMIC OBSERVATIONS FROM FLIGHT TESTS OF TWO VTOL AIRCRAFT

F. B. Gustafson, Robert J. Pegg, and Henry L. Kelley *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va. Nov. 17-18, 1960 p 149-169 (See N63-14683 10-04)

Research on the effects of ground proximity, wing-stall phenomena, pitching moments, and power-requirements of a tilt-wing (VZ-2) and a tilt-duct (VZ-4) is reviewed. This work was done with flight measurements of aerodynamic characteristics and is intended to help bridge the gap between pilot experience and wind-tunnel or theoretical results. Suggestions are made concerning V/STOL design philosophy for taking greater advantage of favorable power-required effects and for dealing with the problems resulting from ground proximity, from flow-separation effects, and from pitching moments arising in decelerating flight. The need is shown for exploiting potential flying qualities and performance gains by use of high-lift devices or other ways of getting more life from less wing area. R.C.M.

N63-14695 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CHARACTERISTICS OF A DEFLECTED-JET VTOL AIRCRAFT

L. Stewart Rolls *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 171-176 (See N63-14683 10-04)

The results of flight tests are summarized for a deflected-jet VTOL aircraft (Bell X-14). This aircraft is powered by two Armstrong Siddeley Viper ASV-8 turbojet engines that are thrust through cascade-type diverters and have reaction jets at the wing tips and at the tail. The problem areas discussed include: height control, varying control power of reaction nozzles with varying engine thrust, and gyroscopic coupling between the pitch and yaw axes. R.C.M.

N63-14696 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECT OF BLADE FLAPPING ON THE DYNAMIC STABILITY OF A TILTING-ROTOR CONVERTIPLANE

Hervey C. Quigley and David G. Koenig *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 177-185 (See N63-14683 10-04)

The basic problems encountered in the testing of the Bell XV-3 convertiplane are reviewed. These problem areas include: (1) high blade-flapping amplitude with steady-state angles of attack and sideslip; increase in flapping due to maneuvering; prop-rotor normal force associated with pitching and yawing angular velocities; and airframe vibration which accompanies airplane angular velocities. It is concluded that at high advance ratios the prop-rotor blade flapping, due to airplane angular velocity, generates a force on the prop-rotor hub in a direction which reduces the dynamic stability of the airplane. R.C.M.

N63-14697 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HIGHLIGHTS OF HANDLING QUALITIES CRITERIA FOR V/STOL AIRCRAFT

Seth B. Anderson *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 187-193 (See N63-14683 10-04)

The V/STOL handling qualities criteria contained in NASA Technical Note D-331 is discussed briefly to point out the reasoning behind these criteria. The handling qualities discussed are: mechanical characteristics of control systems; longitudinal stability and control characteristics; acceleration-deceleration characteristics in transition; control effectiveness in takeoff and landing; lateral-directional control and stability characteristics; and stalling characteristics. While these criteria are subject to modification as more information becomes available, they should serve as a useful guide in writing specifications for an operational VTOL assault transport. R.C.M.

N63-14698 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

CRITERIA FOR PRIMARY HANDLING QUALITIES CHARACTERISTIC OF VTOL AIRCRAFT IN HOVERING AND LOW-SPEED FLIGHT

Robert J. Tapscott *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 195-205 1 ref (See N63-14683 10-04)

The criteria which have been established for the primary handling qualities of helicopters is discussed and shown to be applicable to the newer VTOL configurations. These criteria are for characteristics during hovering and low-speed flight and during transition flight. The criteria for the use of stability augmentation devices are discussed in relation to these flight regimes. It is concluded that adherence to these minimum criteria will result in a good start toward obtaining vehicles with reasonable flying qualities. R.C.M.

N63-14699 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ATTITUDE CONTROL REQUIREMENTS FOR HOVERING DETERMINED THROUGH THE USE OF A PILOTED SIMULATOR

Alan E. Faye, Jr. *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 207-222 4 refs (See N63-14683 10-04)

Simulated flight tests have been made to determine the control boundaries of a VTOL aircraft during hovering. The tests were made with the Ames two-degree-of-freedom motion simulator, and the results are discussed in terms of control power and damping requirements for attitude control about all three axes: pitch, roll, and yaw.

Tests were made about each axis separately, about two axes simultaneously with and without control harmonization, and with the addition of gyroscopic coupling. The results show that the control boundaries become more restrictive with two axes simultaneously and with gyroscopic coupling. A comparison of these results with VTOL flight experience shows good agreement. R.C.M.

N63-14700 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE USE OF PILOTED SIMULATORS IN THE STUDY OF VTOL FLIGHT

Donovan R. Heinle *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 223-234 (See N63-14683 10-04)

This paper discusses some of the factors affecting piloted flight simulation and the use of simulators in the study of flight techniques. Related pilot flight experience and engineer simulator experience is shown to enhance the reliability of simulation data. Proper cockpit mechanization is an important aid to the pilot during simulated flight. Increased degrees of freedom add to the realism of simulation but may be superfluous in the computation. Cockpit motion, however, provides the pilot with cues which otherwise must be interpreted visually. R.C.M.

N63-14701 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

OPERATIONAL ASPECTS OF V/STOL AIRCRAFT

James B. Whitten *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 235-245 (See N63-14683 10-04)

The operational aspects of V/STOL aircraft are discussed for ground handling, takeoff and transition, engine-out characteristics, and instrument approaches and landings. The introduction of VTOL types is shown to be feasible with minimum disruptions of present operations practices and procedures. Effects of high slipstream velocities must be carefully considered in the establishment of ground taxiing, takeoff, and landing areas. Partial power operation of VTOL's will probably be somewhat safer than for comparable helicopters. Steep instrument approaches will be limited to a minimum speed of 25 knots and a maximum angle of 15° until improved instrumentation permits lower speed. R.C.M.

N63-14702 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

OPERATING PROBLEMS OF V/STOL AIRCRAFT IN STOL-TYPE LANDING AND APPROACH

Robert C. Innis and Curt A. Holzhauser *In* NASA. Langley Research Center, Langley Field, Va. NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 247-259 5 refs (See N63-14683 10-04)

The operating envelope of a STOL aircraft has been examined, and limitations which the pilot must heed when choosing his minimum approach speed have been elucidated. Flight and wind tunnel tests have demonstrated the ability of transport type airplanes to utilize propeller slipstream effects in conjunction with conventional high lift devices to achieve short landing distances. These tests indicate that the landing distance can be halved; to realize this reduction, a thrust-to-weight ratio of the order of 0.4 will be required. To obtain further significant gains would require much higher thrust-to-weight ratios and would lead to the complexity and expense of the VTOL vehicles. A.R.B.

N63-14703 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

CONSIDERATIONS OF THE EFFECT OF VTOL DOWNWASH ON THE GROUND ENVIRONMENT

Thomas C. O'Bryan *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 261-268 1 ref (See N63-14683 10-04)

The ground erosion associated with VTOL downwash is considered. The most serious effect of erosion arises when the dynamic pressure is sufficient to dig a crater in the ground. The crater represents a source of material to be recirculated, and the sides of the crater provide a path for the eroded material to be projected vertically into the rotor. In addition, eroded material moving radially may encounter ground objects large enough to project them vertically into the rotor or onto the airframe. Ground erosion becomes a problem as disk loading is increased, but more operating experience is needed to define the tolerable limits. The disk loading problem is restricted to the immediate vicinity of the aircraft, however, because beyond this area the outward flowing sheet of air is dependent only on the gross weight of the aircraft. Furthermore, the thickness of the outward flowing sheet of air decreases directly with decreases in the diameter of the slipstream. M.P.G.

N63-14704 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

NOISE CONSIDERATIONS IN THE DESIGN AND OPERATION OF V/STOL AIRCRAFT

Domenic J. Maglieri, David A. Hilton, and Harvey H. Hubbard *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 269-284 12 refs (See N63-14683 10-04)

Available propulsion-system noise data have been applied to the problems of design and operation of V/STOL aircraft. In particular, considerations have been given to minimizing adverse community reaction for operations between airports and to minimizing detection due to noise for military missions. For minimizing adverse community reaction, configurations incorporating low-blade-loading rotors, low-tip-speed propellers, or turbofan-type engines are judged to be most satisfactory. For minimizing detection, consideration must be given to minimizing the noise of the generating airplane, having maximum background noise in the vicinity of the observer, and operating the aircraft at minimum altitude. Author

N63-14709 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

SUMMARY OF THE V/STOL STATE OF THE ART

Charles H. Zimmerman *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 335-345 (See N63-14683 10-04)

The major points which have been presented in the papers at this conference are summarized to point out the present status of research on V/STOL aircraft and to present some of the needs for future research in this area. The conclusions drawn from this summary are: (1) It is now possible to build V/STOL aircraft suitable for operational testing and evaluation and possibly as service aircraft. (2) A great deal of intensive research is still required to permit the construction of optimum V/STOL aircraft having the greatest utility and productivity. (3) The type of information needed for further development is that which can be obtained only from operational experience with V/STOL aircraft. (4) Design and construction should proceed now on the best aircraft which the state of the art can produce. R.C.M.

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-14290 Cornell U. Center for Radiophysics and Space Research, Ithaca, N.Y.

BIBLIOGRAPHY OF NATURAL RADIO EMISSION FROM ASTRONOMICAL SOURCES—VOLUME FOR 1961

Martha Stahr Carpenter, ed. Sept. 15, 1962 253 p 547 refs
(NSF Grant 22414)

This annotated bibliography contains references to publications dealing with the aspects of radio astronomy that concern radio emissions originating in such astronomical sources as the sun, the galaxy, discrete sources outside the solar system, the moon, the planets, and the comets. A section is devoted to techniques and apparatus. I.v.L.

N63-14317 Harvard Coll. Observatory, Cambridge, Mass.

CLASSIFICATION OF SOLAR PROMINENCES FOR SUNSPOT CYCLE NO. 19-1956 Scientific Report

Donald H. Menzel and F. Shirley Jones Jan. 1963 98 p
(Contract AF 19(604)-4962)
(Rept. 16; AFCRL-63-200)

Behavior classifications and measures of position and size for the solar prominences on the surveys made at the Sacramento Peak Observatory, Sunspot, New Mexico, for the year 1956 are tabulated. An analysis of the distribution of the various classes of prominences with solar latitude is carried out. A similar study for the year 1955 appeared in Scientific Report No. 13. Author

N63-14469 Chicago U., Ill.

CHANDRASEKHAR'S X-, Y-, AND RELATED FUNCTIONS Research Paper No. 9

Yousef Sobouti (Yerkes Observatory) Repr. from Astrophys. J., Suppl. Ser., v. 7, no. 72, Jan. 1963 p 411-560 6 refs
(NASA Grant NsG-118-61)

Chandrasekhar's X- and Y-functions, and four additional functions derived from them, have been tabulated for the values of optical depth in the range 0.1 to 3.0, the values of albedo in the range of 0.10 to 1.00, and the values of argument μ in the range 0 to 20. Author

N63-14491 Stanford Research Inst., Menlo Park, Calif.

ERRORS IN THE MEASUREMENT OF THE TEMPERATURE OF THE MOON

Eugene A. Burns and R. J. P. Lyon 5 p 9 refs Repr. from Nature (London), v. 196, no. 4853, Nov. 3, 1962 p 463-464
(NASA Contract NASr-49(04))

Observations of the temperature and composition of the lunar crust made by instruments above the earth's atmosphere will require different interpretation techniques than data obtained through the atmosphere. Therefore, the effect of composition on the emissivity of several smooth surfaces was investigated as a function of wavelength, and the surface emittance was calculated at several temperatures. Comparisons of the emittance curves of quartz at six temperatures demonstrate that (1) the wavelength of maximum energy cannot be used to evaluate the temperature from the Wien law, and (2) the dependence of average emissivity on temperature is a second-order effect, so that measuring temperature changes of the same material by radiometric methods is valid. However, absolute values of the temperature obtained may be significantly in error. Because of the predominance of the strong Si-O vibrational bands near 9-10μ for most minerals, a situation similar to that for quartz is assumed to exist for lunar surfaces, although the porosity of the lunar surface may make the deviation from the ideal emissivity curve less obvious. M.P.G.

N63-14669 High Altitude Observatory, Boulder, Colo.

ÉTUDE DES RAIES D'ÉMISSION DE He I DANS L'ATMOSPHÈRE SOLAIRE. I. LES PROFILS DE LA RAIE TRIPLET INFRAROUGE, λ 10830 Å [STUDY OF THE LINES OF EMISSION OF He I IN THE SOLAR ATMOSPHERE. I. THE PROFILES OF THE INFRARED TRIPLET LINE 10830 Å]

Einar Tandberg-Hanssen Repr. from Ann. Astrophys. (Paris), v. 25, no. 5, 1962 p 357-366 21 refs In French; English Summary
(NASA Grant NsG-136-61)
(*Its* reprint 264)

The emission is the pseudo resonance line of neutral helium, the infrared triplet line λ 10830 Å, has been studied in different parts of the solar atmosphere. The profile is distinctly different in the chromosphere and in quiescent prominences. It shows a broad, flat top and a "hump" in the blue wing in the chromosphere, whereas the typical prominence emission gives a well-defined double line whose blue component is significantly stronger than the theoretical (optically thin case) value. Flare profiles seem to belong to a well-defined third class, while active prominences give emission profiles of more varied shapes, generally intermediate in character between the profiles from quiescent prominences and from the chromosphere. From a study of the shape of the profiles, especially the strength of the blue component, we draw inferences on the source function and optical depth in the line. It is concluded that the chromospheric emission corresponds to a tangential optical depth of about 2 to 4, and that most of the prominences studied were not formed under optically thin conditions. Author

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-14234 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

A REALISTIC APPROXIMATION TO THE EFFICIENCY OF THERMIONIC POWER GENERATORS

A. E. Fein and L. S. Richardson Dec. 20, 1960 40 p 5 refs
(Sci. Paper 12-1401-1-P2)

A simple model has been constructed to enable the calculation of the operating characteristics of a thermionic diode. In this model, it has been assumed that space charge has been eliminated by means of a partially ionized plasma whose sole effect on the diode is to introduce an internal electrical resistance and thermal conductance. The efficiency of conversion of diodes of fixed parameters was then optimized with respect to lead resistance and operating voltage. Account was taken of back current and of the voltage drop, thermal conduction, and Joule heating of the leads and plasma. A criterion for the lifetime of a thermionic converter was developed, based upon the evaporation rate of the cathode. From this criterion, a relation between the heat of vaporization of the cathode and the maximum temperature at which it can be operated was deduced. From the latter quantity, a means of calculating the ultimate efficiency attainable with a given cathode material is described. Author

N63-14450 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

SOLAR-CELL POWER SYSTEMS TESTING

John A. Zoutendyk Dec. 17, 1962 23 p 7 refs
(NASA Contract NAS7-100)
(JPL-TR-32-350) OTS: $2.60 ph, $0.89 mf

The use of high-altitude balloon flights in determining the earth space short-circuit current of solar cells is discussed in this report. The application of balloon-flight measurements to the determination of solar-cell spectral correction factors is outlined. Author

N63-14471 Watkins-Johnson Co., Palo Alto, Calif.

APPLIED RESEARCH ON A HIGH-POWER MILLIMETER-WAVE GENERATOR Interim Engineering Report No. 7, Dec. 1, 1962 through Feb. 28, 1963

James W. Sedin [1963] 24 p

(Contract AF 33(616)-8369)

The purpose of this program is to demonstrate the feasibility of generating very high power, specifically, 100-kw peak and 1000 watts average at 100 gc, by means of an O-type backward-wave oscillator operating at very high voltage. Experimental tube no. 2 was completed and tested. RF pulse shapes obtained were very much improved over those obtained from tube no. 1, indicating that the circuit match was good. There was some evidence of higher order mode oscillations. The 435-1B gun structure was modified slightly to produce a smaller beam diameter. Test results on this new gun structure are presented. The high-power waveguide loads, which consist of 0.122-inch-square waveguide with lossy glaze material on the walls, were found to have made problems, and it was impossible to calibrate the loads accurately. The output waveguides from the tube have been reduced to 0.050 × 0.100 inch. Two electroformed circuits have been completed and brazed into the supporting blocks. Author

N63-14522 Lockheed Missiles and Space Co., Sunnyvale, Calif.

NEW CATHODE-ANODE COUPLES USING NONAQUEOUS ELECTROLYTES [Final Report] Dec. 1961–Aug. 1962

J. E. Chilton and G. M. Cook Wright-Patterson AFB, Ohio, Flight Accessories Lab., Dec. 1962 57 p 3 refs

(Contract AF 33(616)-7957)

(LMSC-2-02-62-2; ASD-TDR-62-837)

New cathode-anode couples using nonaqueous electrolytes are investigated as possible secondary batteries for use in orbiting satellites. These studies are directed toward the construction of an operating secondary system. A lithium anode is used with either a silver chloride or nickel chloride cathode in an electrolyte consisting of propylene carbonate, aluminum chloride, and lithium chloride. Author

N63-14538 National Gas Turbine Establishment, Pyestock (Gt. Brit.)

AN APPROXIMATE METHOD FOR THE ESTIMATION OF THE DESIGN POINT EFFICENCY OF AXIAL FLOW TURBINES

D. G. Ainley London Ministry of Supply, Aug. 1949 26 p 11 refs

(NGTE-M-59) (Declassified)

A method is outlined for making rapid approximate estimates of the design point efficiency of conventional axial flow turbines. For a number of existing turbines, a comparison has been made between the predicted efficiencies and the efficiencies actually recorded on test. As a result of this comparison, a final empirical correction to the calculated efficiencies is suggested to give final predictions which should compare favorably with actual values. It appears from the analysis that the turbine stage temperature drop coefficient and the stage reaction are of major significance when considering stage efficiency. Contemporary units show relatively poor efficiency when designed for a high-temperature drop coefficient, and the reflection of this upon the choice of an optimum turbine design for certain applications such as long-range aircraft, industrial, and marine plant is briefly discussed. Author

N63-14555 Illinois U. Coordinated Science Lab., Urbana

AUTOMATIC AIR TRAFFIC CONTROL. PART I: A PROJECTED SYSTEM

L. S. Kypta Aug. 1962 41 p

(Contract DA-36-039-SC-85122)

(Rept. R-145)

The automatic air-traffic-control system described in the report consists of automatic control centers for en route control and small satellite computers for approach-departure control. Each automatic control center is composed of 5 automatic sections providing the following functions: (1) position gathering and tracking, (2) internal communication, (3) manual input and display, (4) control, and (5) information storage. An automatic center is capable of controlling over 1000 aircraft simultaneously. Each satellite computer is intended to control approaching and departing aircraft for one airport and is capable of controlling 50 flights simultaneously. The goal in the design of the system is to provide a system that in no way hinders traffic flow and also is safe and simple to use. To achieve this goal, it is necessary to automate all processes in which information flows in large quantities or is rapidly changing. The most important process falling in this category is decision making; consequently, decision making has been automated. All processes in which information is slowly changing or infrequently exchanged are to be executed manually. Author

N63-14603 Space Technology Labs., Inc., Redondo Beach, Calif.

CONTINUATION EFFORT—SIS BAMBI. PHASE II: FEASIBILITY STUDY, VOLUME II Final Technical Summary Report [Oct. 2, 1962-Jan. 31, 1963]

John Mandrow Feb. 28, 1963 139 p 37 refs

(Contract AF 04(695)-10; ARPA Order No. 177-61; Proj. Defender)

(Rept. 8637-6116-RU000; SSD-TDR-63-24)

The SIS BAMBI continuation effort consisted of six tasks. Investigation of boost track-system technology showed the data-smoothing problem to be central to this concept. The smoothing error depends upon availability of valid model information. An optimistic estimate of the accuracy of cutoff velocity determination is 10 ft/sec. A small test program substantiated the feasibility of operating a precision track-while-scan infrared tracker. Investigation of redundant circuit designs indicates that such techniques can bring significant reliability improvements. However, the extent of such improvements cannot be estimated accurately by simple scaling from a nonredundant design. A study and test program indicates the feasibility of utilizing a dual-membrane, ring-reinforced bladder as a positive expulsion system which minimizes cg shifts and attitude disturbances. A study and simulation program indicates the feasibility of employing a self-contained geomagnetic attitude control system to control the spin-axis orientation and the spin speed of a spin-stablized, low-altitude earth satellite. The foregoing investigations are summarized in Volume I. The results of an analysis and simulation of a pulse frequency modulated spacecraft attitude control system are presented in Volume II. Author

N63-14639 Ampex Corp., Redwood City, Calif.

INDUCTION GENERATOR STUDY

Arthur E. Young Feb. 1963 12 p

(TB-63-3)

Induction generator experiments are directed toward the development of a kinetic energy storage system that can be incorporated into the power supply of a high-speed tape transport. It was hoped that a means of realizing an energy storage system operating on alternating current, rather than direct current, would be uncovered by the experiments. This discovery would lower operating costs. Also, higher power frequencies, with no power surges due to rapid acceleration or stopping, could be generated, and emergency procedures in cases of line power failure would be simplified. However, it was found that the internal impedances of an induction generator restrict the useful range of operation to approximately 30 percent above synchronous speed. A machine with an eddy-current rotor performs very well as a voltage generator on open circuit, but is useless as a current generator. For application to a stored-energy power supply, an induction generator would need separate windings for each output frequency, and the speed variations should be restricted to ±10 percent. In addition, the poor voltage regulation of an induction generator necessitates regulation of the excitation current up to several amperes. It is concluded, therefore, that an induction generator is impractical for the projected application. D.E.R.

N63-14664 Atomics International, Canoga Park, Calif.
SNAP AEROSPACE SAFETY PROGRAM Quarterly Technical Progress Report, Oct.-Dec. 1962
Apr. 1, 1963 41 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-8097) OTS: $1.00

The subject material covers the following major projects in the Aerospace Safety Program: reactor transient and excursion tests, fission product release studies, end-of-life shutdown devices, critical configuration studies, mechanical and thermochemical effects, reactor separation and fuel element ejection, and reentry burnup of fuel elements. The design of the SNAPTRAN 2/10A-1 and -2 machines was essentially completed and fabrication of major components was initiated. The fission-product-release tests at the NRTS were completed. Some progress was made on the explosive shutdown projectile design. A practical shipping-sleeve design was demonstrated which will maintain the SNAP 2/10A assembly in a subcritical condition as a result of postulated shipping accidents. The Phase I Ground Test Series at Holloman AFB were completed. The computer code, RESTORE, was shown to be excellent for the calculation of reentry trajectories. The calculation of fuel-rod heating and ablation using the current Digital Thermal Analyzer Program resulted in an improved and more elaborate analytical model. Author

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Non-metallic; and 26 Propellants and Combustion.

N63-14257 AeroChem Research Labs., Inc., Princeton, N.J.
CONVECTIVE DIFFUSION AS AN INTRUDER IN KINETIC STUDIES OF SURFACE CATALYZED REACTIONS
Daniel E. Rosner Mar. 4, 1963 74 p 100 refs For presentation at the Propellants and Combustion Session of the American Inst. of Astronautics Natl. Summer Meeting, Los Angeles, June 16-19, 1963
(Contracts AF 49(638)-1138 and AF 49(638)-1195)
(TP-63)

This paper reviews the current state of knowledge in the intermediate regime where both the chemical kinetics and diffusion govern the observed reaction rates, and outlines applications of available theory as well as areas in need of further development. In particular, boundary-layer flows are shown to form an important class of flow systems for which a complete theoretical treatment is feasible. Exact and approximate computational methods are described and results are presented for both laminar and turbulent boundary-layer flows developing along catalytic solids. An interaction is shown to exist between the physical and chemical processes involved, the origin of which is discussed on physical grounds. Neglect of this coupling causes unacceptably large errors in the inference of chemical kinetic parameters, particularly for (1) surface reactions of small kinetic order in laminar flow systems, (2) sequential reactions, and (3) reactions with appreciable thermal effect. Available solutions can be used to obtain true chemical kinetic parameters from experimental data in much the same way as in static systems, and certain analogies between the effects of external and internal (pore) diffusion are discussed. Author

N63-14281 Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S.C.
LOW TEMPERATURE STILL FOR SEPARATION OF HYDROGEN ISOTOPES
Ben. S. Johnson and Francis G. Rust Sept. 1962 36 p 13 refs
(Contract AT(07-2)-1)
(DP-732) OTS: $0.75

Separation of hydrogen isotopes by continuous distillation was demonstrated with hydrogen and deuterium in a pilot-scale still with a packed column two inches in diameter. Theoretical plate heights of one to four inches were observed. Excellent insulation was essential to avoid excessive consumption of liquid-hydrogen coolant. A novel method for data evaluation in ternary distillation is presented. Author

N63-14282 Naval Ordnance Lab., White Oak, Md.
THE REACTION OF ALLYLTRICHLOROSILANE WITH GLYCIDYL METHACRYLATE
Robert Brown Feb. 1963 15 p 10 refs
(NOLTR 62-166)

The reaction of epoxides with chlorosilanes has been applied to the synthesis of several polymers. In particular, allyltrichlorosilane reacts with three moles of glycidyl methacrylate to form a monomer which can be converted to a clear, hard polymer. Chemical and infrared evidence is presented for the manner in which the monomer is formed, its structure, and the manner in which it polymerizes. Electrical volume resistivity measurements were used to find the optimum polymerization conditions and to ascertain qualitatively the degree of crosslinking. Author

N63-14357 Sheffield U. (Gt. Brit.)
THE TRIPLET STATE Final Technical Report
George Porter Mar. 30, 1963 26 p 13 refs
(Contract AF 61(052)-32)
(AFCRL-62-626)

The first order decay of triplet states of naphthalene, anthracene, phenanthrene, and their halogenated derivatives has been studied in cyclohexane and viscous paraffin solutions. The decay results partly from a bimolecular quenching process and partly from a true first-order radiationless conversion to the ground state. The rate of the quenching process is a function of the solvent and, in anthracene derivatives, of the extent to which the solutions have been irradiated. The rates of radiationless conversion can only be measured when they exceed the rates of quenching processes. This is the case for all the anthracene derivatives in viscous paraffin, for the bromoanthracenes in cyclohexane and probably for bromophenanthrene in viscous paraffin. Bromination of anthracene is ten times more effective in enhancing conversion than chlorination at the same position, and halogenation at the 9,10 positions has four times the effect of halogenation at other positions. In the one case where it could be tested (dibromoanthracene), the rate of radiationless conversion was unchanged by a 170-fold increase of solvent viscosity. Author

N63-14365 Naval Ordnance Lab., White Oak, Md.
APPLICATION OF CHLOROSILANE FINISHES TO GLASS FIBERS USING THE AZEOTROPIC DISTILLATION METHOD
Porter W. Erickson and Michael J. Mc Greal Feb. 1963 30 p 18 refs
(NOLTR-63-1)

The tendency of certain solvents to form low-boiling mixtures (azeotropes) with water was investigated as a means by which to strip surface adsorbed water from glass fibers prior to treatment with NOL-24, a chlorosilane. Neither the loading of finish on the fabric or the effectiveness of the treatment correlated with the presumed different stripping powers of the solvents tried. Results with chloroaromatic solvents indicated that they have substantial potential in the development of an effective, nonaqueous, large-scale process for applying chlorosilane finishes to glass-fiber reinforcement. Author

N63-14373 Aerospace Information Div., Library of Congress, Washington, D. C.

CATALYTIC EFFECT OF SOME METAL POLYCHELATES

Mar. 14, 1963 17 p 22 refs

(AID S-63-34) OTS: $1.60 ph, $0.80 mf

The Soviet study of metal polychelates was prompted by a seemingly insignificant difference found in the properties of sodium and copper salts of dithiocarbamate complexes. The discovery of a chelate (or sandwich) structure of copper salts in turn led to the discovery of polymers with the same peculiar structure held together by transition metals. These polymers displayed many desirable properties, among them considerable chemical and heat resistance, and an attempt was made to bring their catalytic properties into a relationship with the wide range of electrical conductivities found. The study was initiated at the Moscow State University, and specialized investigations were delegated to two other prominent scientific research institutes. A device to find organometallic compounds which could close the gap between the inorganic catalysts and organic ferments was given as the ultimate purpose of the investigation. Author

N63-14376 Union Carbide Research Inst., Tarrytown, N.Y.

RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES Quarterly Progress Report [Jan. 1-Mar. 31, 1963]

Robert Lowrie Mar. 31, 1963 85 p 20 refs

(ARPA Order 34-63; Contract DA-30-069-ORD-2787)

Physical and chemical principles affecting high-temperature materials for rocket nozzles are reviewed. (1) New data are reported on: the oxidation of TiC, HfC, HfB_2, and TaB_2 by CO_2 at 2250° C brightness temperature; the corrosion of ZrO_2, TiC, ZrC, NbB_2, and TaB_2 by HCl at 2250° C brightness temperature; and the corrosion of ZTA graphite in CO_2 at 2250° C brightness temperature. (2) The products obtained when a molecular beam of oxygen impinges on a hot tungsten filament have been determined for filament temperatures from 800° C to 2200° C brightness temperature. With increasing temperature, the predominant tungsten-bearing ions detected mass spectrometrically are in turn $(WO_3)_3^+$, $(WO_3)_2^+$, WO_3^+, WO_2^+, and W^+. (3) The thermal expansion of TaC has been measured by an X-ray method to 2044° C, and a value has been obtained for the expansion of NbC at 2031° C. Measurements of the thermal expansions of solid solutions have been made on 25 TiC/75 ZrC up to 1771° C. (4) A discussion is given, in terms of band models, of the galvanomagnetic measurements which have been made on various refractory carbides, nitrides, and solid solutions between them. (5) A new method for calculating upper and lower bounds for the elastic moduli of a randomly oriented polycrystalline body from the elastic constants of a single crystal of the material has been applied to single-crystal data previously obtained for TiC and ZrC. The resulting upper and lower limits are very close, and average values are reported for the shear moduli, Young's moduli, and Poisson's ratios of these compounds. (6) Tungsten has been successfully brazed to tungsten and this method of brazing will be used to prepare specimens for measurements of the elastic constants of tungsten single crystals to 1800° C. (7) Creep tests on two large-grained specimens of ZrC resulted in brittle features during or shortly after the applications of load increments at 1623° C and 1815° C. I.v.L.

N63-14403 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

EFFECT OF OXYGEN ON MECHANICAL PROPERTIES OF TUNGSTEN

Joseph R. Stephens Washington, NASA, Apr. 1963 24 p 15 refs

(NASA TN D-1581) OTS: $0.75

The effect of oxygen on the mechanical properties of commercial polycrystalline tungsten and zone-refined single-crystal tungsten was evaluated by means of tensile tests of oxygen-doped specimens in the ductile-to-brittle transition temperature range. The effect of oxygen as a surface oxide that might be encountered in normal working and forming operations was evaluated by means of a three-point loading bend test at room temperature. Results showed that the commercial recrystallized rods containing 4 parts per million (ppm) oxygen had a ductile-to-brittle transition temperature (based on 50-percent reduction in area) of 450° F. Increasing the oxygen concentration to 10, 30, and 50 ppm increased the transition temperature to 660°, 840°, and 1020° F, respectively. The oxygen additions also produced a progressive lowering of the ultimate tensile strength. The mechanism for the effect of oxygen on the transition temperature and ultimate tensile strength is believed to be that of segregation of the oxygen atoms at the grain boundaries. The oxygen additions also caused a progressive lowering of the yield strength, which is believed to result from the interaction of oxygen with carbon atoms or other impurity atoms present in the tungsten lattice. Oxygen additions to the single-crystal specimens had a slight effect on ductile-to-brittle transition temperature. There was very little change in the ultimate tensile strength or yield strength of the single-crystal specimens as a result of increasing the oxygen concentration. These results on high-purity single crystals support the belief that the detrimental effect of oxygen on ductility and tensile strength of polycrystalline tungsten is a result of grain boundary segregation of the oxygen. A surface oxide that resulted from heating the specimens in oxygen at 1000° F did not affect the ductility of the tungsten rod. Oxidizing the rods at 1500° F increased the ductility of the bend specimens, which is believed to be a result of the removal of surface defects from the ground rod. Author

N63-14408 Gt. Brit. Ministry of Aviation. Technical Information Library Services, Mottingham

STUDIES OF COLOURED FLAME COMPOSITION OF FIREWORKS. 3RD REPORT ON BACKGROUNDS OF COLOUR FLAME SPECTRA

T. Shimizu Feb. 1963 18 p 2 refs Transl. from Kogyo Kayaku Kyokaishi (Tokyo), v. 20, no. 1, 1959 p 19-28

(TIL/T-5129)

Blank runs were made with compositions which were not nominally color-producers to investigate any background effects influencing the colors required. Materials tested included oxidizers and low-temperature combustibles (Shellac, tar, rosin, etc.). The spectra obtained are discussed and purity of compounds considered. Permeability coefficients and black-body temperature of flames of basic compositions are measured for reference. Author

N63-14470 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.

PREPARATIVE STUDIES OF LINEAR POLYMERS CONTAINING ALUMINUM

Walter J. Erich Mar. 1963 17 p 16 refs

(Picatinny Arsenal TM-1060)

Dimers and trimers containing chelated aluminum were prepared from acetoacetic ester and 8-hydroxy-quinoline. It is assumed that, upon hydrolysis, corresponding hydroxy compounds are formed which condense at higher temperatures to form aluminum oxygen bridges. Polymer-like products were synthesized from stearic, heptanoic, and benzoic acids and aluminum ethoxide. Although the exact structures of these polymers are not definitely known, they are characterized by having an aluminum-oxygen-aluminum polymer chain with lateral carbalkoxy groups attached to the aluminum atom. Steric hindrance was believed to be the cause of the failure of 8-hydroxy-quinoline to polymerize. This condition was overcome by the introduction of the bulky aluminum ethoxide radical after the hydroxy-quinoline molecules were linked together by methylene bridges. Polyaluminoxanes made from 8-hydroxy-quinoline exhibited the best thermal stability. Author

N63-14485 Texaco Experiment Inc., Richmond, Va.

INVESTIGATION OF THE DISSOCIATION CHEMISTRY OF $-NF_2$ COMPOUNDS Quarterly Summary Report for Nov. 1962 through Jan. 1963

U. V. Henderson, Jr., P. L. Goodfriend, and H. A. Rhodes Feb. 1, 1963 12 p 4 refs
(Contract Nonr-1883(00))
(EXP-223; TM-1407)

The testing and debugging of equipment for both the photolytic and thermal dissociation studies of $-NF_2$ compounds has been completed. The design of the flash tubes used in the photolysis work has been modified to minimize the occurrence and inconvenience of exploding tubes; flash durations have been timed; and the sequential flash-delay circuit has been calibrated. Preliminary spectral studies have been started. The adiabatic compression apparatus has been tested on the mass spectrometer with inert gases and was found to operate satisfactorily. The high-speed drum camera has been received and coupled with the apparatus. Author

N63-14492 Naval Ordnance Lab., White Oak, Md.
UNRESOLVED FINE STRUCTURE OF THE NITRIC OXIDE GAMMA O-O BAND FOR THE DETERMINATION OF TEMPERATURE
David Levine June 18, 1962 44 p 13 refs
(NOLTR-62-65; Ballistics Res. Rept. 63)

An experimental program was conducted to investigate the properties of the unresolved rotational fine structure of the nitric oxide gamma O-O band. The experimental values were taken spectroscopically in absorption at controlled temperatures. An analytic expression representing the unresolved rotational fine structure is utilized to compute absorption coefficients and intensities of absorption for the experimental temperatures. A doublet model, a modified doublet model, and a singlet model of the band were investigated. Experimental values for the intensity of absorption compared well with computed values from the doublet model over the band. Agreement also existed in the wings of the band when the singlet model was investigated. From the experimental absorption coefficients, temperatures were determined to within 6 percent of the directly measured values. The rotational constants of the upper and lower states could be determined to 13 percent and 6 percent, respectively, of the known values. Author

N63-14516 Army Missile Command, Redstone Arsenal, Ala.
A STUDY ON OXYGEN-WATER VAPOR MIXTURES UNDER RF EXCITATION BY ELECTRON-PARAMAGNETIC RESONANCE TECHNIQUES
D. W. Howgate May 14, 1962 54 p 14 refs
(AOMC-RR-TR-62-3)

This report deals with a study of applicability of the paramagnetic resonance technique to analyze combustion products of fuel mixtures ignited by RF discharges. Qualitative as well as quantitative determination of atomic hydrogen, atomic oxygen, molecular oxygen, and hydroxyl radical was obtained from the EPR spectrum. Specifically, upon application of RF discharge on mixtures of water vapor (partial pressure, 50 to 200 microns) and oxygen (partial pressure, 0 to 300 microns) the following information was obtained: (1) The absence of the OH species below 100 microns water vapor pressure, and of the O species above 130 microns water vapor pressure, (2) the lack of dependence of these cutoff pressures on the amount of oxygen added to the water vapor previous to the discharge, (3) the enhancement of the OH radical up to five times upon addition of sufficient oxygen to the mixture, and (4) the existence of the OH radical in a total concentration of less than one percent when observed. These results indicate that the extension of the paramagnetic resonance technique to measure the combustion products of fuel mixtures ignited by RF is feasible. Detection of atomic nitrogen, methyl, and other radicals by this technique is also possible. Author

N63-14529 Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN MIXTURES OF URANIUM AND TUNGSTEN
A. D. Hues and A. L. Henicksman Mar. 20, 1963 12 p 3 refs
(Contract W-7405-eng-36)
(LA-2844) OTS: $0.50

Uranium is determined in mixtures of uranium and tungsten, using 3-(2-arsonophenylazo)-4,5-dihydroxy-2,7-naphthalenedisulfonic acid (arsenazo) as the chromogenic agent. The colored complex is developed by the addition of arsenazo to aliquots of the sample solution, which have been treated with tartaric and boric acids and suitably buffered, and is measured spectrophotometrically at 600 mμ. The selectivity of the method is improved by the use of EDTA as a masking agent. Forty-eight determinations of uranium, in solutions containing known amounts of uranium and tungsten to simulate alloys containing 20% to 65% of uranium, gave an average recovery of 99.9% with a standard deviation of 0.36% for a single measurement. Most of the metals likely to be encountered as impurities can be tolerated in amounts up to 10% of the amount of uranium present. Author

N63-14565 Stanford Research Inst., Menlo Park, Calif.
RATES OF CHARGE PRODUCTION IN THE NITROGEN AFTERGLOW
C. R. Gatz, F. T. Smith, and H. Wise Charlottesville, Va. U. School of Eng. and Applied Sci., Mar. 1963 23 p 13 refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(SRI-16-P)

Charge-production rates in the nitrogen afterglow were obtained from saturation-current measurements. The results for various values of total pressure, initial nitrogen atom concentration, and rate of addition of NO show that the ionization may be the result of one or more of the following reactions:

$$N_2^* + N + O \rightarrow N_2 + NO^+ + e;$$
$$N_2^* + NO^* \rightarrow N_2 + NO^+ + e;$$
$$N + N + NO^* \rightarrow N_2 + NO^+ + e$$

where N_2^* is a long-lived and NO^* a short-lived metastable state. Author

N63-14585 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ELECTRON TRANSFER REACTIONS AND THE FORMATION OF POLYRADICALANIONS
A. Rembaum and J. Moacanin Jan. 1963 Repr. from Polymer Letters, v. 1, Jan. 1963 p 41-45 6 refs
(NASA Contract NAS7-100)
(JPL-TR-32-393)

An alkali metal and complex vinyl-phenolic compounds were reacted to form polymers containing radical-anions distributed along the chain. This class of polymers, referred to as polyradical-anions, exhibits intramolecular electron transfer due to resonance. The result is the degradation of the product due to the bond dissociation of electron migration from the aromatic rings to the alpha-carbon of the aliphatic chain. Spectroscopic studies of these polymers are being conducted and a table of their resonance energies is being prepared. The polymers can be modified in several ways due to the many reactive sites distributed within the compounds. D.E.R.

N63-14598 California U., Livermore. Lawrence Radiation Lab.
THE DETERMINATION OF SULFUR IN BERYLLIUM OXIDE AND SINTERED BERYLLIUM OXIDE FUEL ELEMENTS
Walter G. Boyle, Jr., Lewis J. Gregory, and William Sunderland Jan. 16, 1963 14 p 7 refs
(Contract W-7405-eng-48)
(UCRL-7204) OTS: $0.50

This report describes a dry combustion procedure for determining sulfur in beryllium oxide and beryllium oxide fuel elements. The sample combined with iron and tin is burned in a stream of oxygen in an induction furnace, and the resulting sulfur dioxide is titrated continuously with iodine. Conditions for determining levels of sulfur content around ten parts per million, as well as the higher levels, are presented and some typical analytical results summarized. Author

N63-14601 F and M Scientific Corp., Avondale, Pa.

A COMPLETELY CONTINUOUS CHROMATOGRAPH FOR PURIFICATION OF BORON COMPOUNDS Final Report

C. B. Euston, J. Peters, F. J. Debrecht, and J. M. Kauss Feb. 21, 1963 49 p

(Contract AF 19(604)-8045)

(AFCRL-62-731)

This report discusses the design and construction of a gas chromatograph to purify a boron compound which is to be later decomposed to pure elemental boron. No commercial unit is currently available to do this either on a truly continuous basis, such as this unit operates, or in the quantities of compound which can be prepared. The difficulties encountered and methods used to solve them are discussed. Successful operation is illustrated by purification of a hydrocarbon mixture, collection of purified fractions, and analysis of these fractions by a highly sensitive flame ionization gas chromatograph. Purities to 99.99% have been obtained. The boron compound chosen for this work was stable pentaborane B_5H_9, a toxic, highly reactive liquid-propellant fuel, which required special design and handling techniques. Author

N63-14616 Carnegie Inst. of Tech., Pittsburgh, Pa.

ELECTRONIC EFFECTS IN BASE-CATALYZED ELIMINATION REACTIONS Final Technical Report

Allan K. Colter Mar. 5, 1963 12 p 12 refs

(Contract DA-36-034-ORD-2957; Grant DA-ARO(D)-31-124-G97)

(AROD-2336-2)

In order to evaluate the importance of electronic effects imposed by the leaving group in E2 reactions, studies of the reactions of a series of 2-pentyl arenesulfonates (I) with ethanolic sodium ethoxide 50° and a of series 2-methyl-3-pentyl arenesulfonates (II) with potassium *tert*-butoxide in 50-50 (vol.) % *tert*-butanol-dioxane at 50° have been carried out. The results of both studies demonstrate that electronic effects imposed by the leaving group can be important in determining orientation in E2 reactions. However, changes in olefin compositions produced by electronic effects in the leaving group are in the opposite direction to those predicted by the generally accepted Hughes-Ingold theory of directive effects in E2 reactions. A modified theory accounting for directive effects in E2 reactions has been proposed. Author

N63-14621 Brush Beryllium Co., Cleveland, Ohio

DEVELOPMENT OF INTERMETALLIC COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS Annual Report, Jan. 1–Dec. 31, 1961

R. M. Paine, A. J. Stonehouse, and W. W. Beaver AEC Div. of Tech. Inform., Sept. 1962 89 p 6 refs

(Contract AT(33-3)-20)

(BBC-115) OTS: $2.00

Investigations as to the nature of and the elimination of intermediate-temperature failure of the beryllides are described. The intermediate-temperature problem manifests itself in a number of ways, including poor oxidation resistance and poor strength and thermal shock resistance at intermediate temperatures. The temperature range over which the problems manifest themselves is dependent upon the particular material but is in the range of 1000° to 2000° F. Among the beryllides, the problems appear to be limited to the zirconium beryllides and, to a lesser extent, to the niobium beryllides. The role of impurities and various additive elements such as iron, nickel, and aluminum is discussed. The addition of aluminum to $ZrBe_{13}$ to the extent of approximately 0.4% completely eliminates accelerated oxidation in the case of $ZrBe_{13}$. Author

N63-14624 Aeronautical Research Lab., Wright-Patterson AFB, Ohio

METHOD FOR DETERMINATION OF THE FREE AND TOTAL TITANIUM CONTENTS IN ZrO_2-Ti COMPOSITIONS

Ross W. Moshier and Robert Ruh Jan. 1963 20 p 4 refs

(ARL-63-13)

Procedures have been developed for the determination of the total titanium content and the free titanium content by chemical analysis. Using these procedures, the amounts of total titanium and free titanium have been determined in ZrO_2-Ti compositions with 0.38, 1.2, 2.0 and 6.4 weight % Ti. With this data, it has been possible to determine the stability of the titanium when present in the free state and in solid solution. Results of the total titanium analysis have revealed that there is no significant loss of titanium at any firing temperature when the titanium is in solid solution in zirconia. Above the solubility limit, vaporization of the free titanium begins at 1500° C, and the rate increases with temperature. Results of the free titanium analyses have shown that there is virtually no free titanium in compositions below the solubility limit. They also have given the amount of free titanium in compositions above the solubility limit. A combination of the data of both analyses has revealed the amount of titanium in solid solution in zirconia. Author

N63-14631 California U., Berkeley. Lawrence Radiation Lab.

BIO-ORGANIC CHEMISTRY Quarterly Report, Sept. through Nov. 1962

Jan. 18, 1963 125 p 127 refs

(Contract W-7405-eng-48)

(UCRL-10634) OTS: $2.50

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N63-14632 California U., Berkeley. Lawrence Radiation Lab.

CARBON-14 AND NITROGEN-15 TRACER STUDIES OF AMINO ACID SYNTHESIS DURING PHOTOSYNTHESIS BY *CHLORELLA*

James A. Bassham, Martha Kirk, and Gerald J. Crowley *In its* Bio-Organic Chemistry Quarterly Report, Sept. through Nov. 1962 Jan. 18, 1963 p 1-12 7 refs (See N63-14631 10-07) OTS: $2.50

A steady-state photosynthetic analysis, using both radioactive isotopes of carbon and nitrogen, was conducted on the amino acid synthesis in *Chlorella pyrenoidosa*. An attempt was made to learn the relative importance of initial points of entry of amino nitrogen into

the biosynthetic pathways; but, although the rapid labeling of alanine suggests the direct incorporation of amino nitrogen into alanine, no unequivocal answer can be given. While almost all the amino groups in the total amino acid pool are labeled, all the carbon chains in the acid pool are not, which suggests synthesis from carbon chains outside the chloroplast. Graphs and tables are presented for the labeling of various amino acids in the pool. D.E.R.

N63-14636 California U., Berkeley. Lawrence Radiation Lab.
ULTRAVIOLET-ABSORBING COMPOUND(S) REPORTED PRESENT IN THE MURRAY METEORITE
John Oró *In its* Bio-Organic Chemistry Quarterly Report, Sept. through Nov. 1962 Jan. 18, 1963 p 114-121 10 refs (See N63-14631 10-07) OTS: $2.50

It is concluded that the uv-absorbing compounds detected in water extracts of the Murray meteorite after treatment with Dowex 1 came from the resin and not from the meteorite. These findings are based on the identity of the maxima, identity of shifts caused by pH changes, and similarity of elution pattern. This conclusion is in line with observations made by Vaughn, but does not rule out the possibilities that some uv-absorbing compounds are present in the Murray meteorite because uv absorption was also found in extracts that had not come in contact with ion-exchange resins. D.E.R.

N63-14646 Tyco Labs., Inc., Waltham, Mass.
THE TRAVELLING SOLVENT METHOD OF CRYSTAL GROWTH Quarterly Report No. 7, Nov. 16, 1962-Feb. 15, 1963
L. B. Griffiths, M. A. Wright, and A. I. Mlavsky Mar. 12, 1963 19 p 3 refs
(Contract AF 19(604)-8803)
(AFCRL-63-75)

P-N junctions in α-SiC made by the Travelling Solvent Method (TSM), exhibit unique forward characteristics, the current density at low voltages being orders of magnitude greater than for SiC diodes made by other techniques. Capacitance measurements indicate that the junctions are abrupt. The diodes retain their rectifying properties up to at least 500° C. Chromium-12% silicon alloy is an excellent solvent for use in growing SiC by TSM. No high vacuum pretreatment of the SiC surfaces is necessary. Author

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-14238 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
EXPERIMENT LUXEMBOURG II Summary Report
H. A. von Biel Jan. 17, 1963 10 p 2 refs
(Contract AF 19(604)-8842)
(CAL-VC-1609-P-1; AFCRL-63-221)

A crystal-controlled, VHF pulse transmitter operating at 14.905 mc, and having a peak pulse power of 200 kw and an average power of 1 kw is described. This transmitter was constructed particularly to act as the "disturbing wave" transmitter for a wave-interaction experiment within a duty cycle of 0.5%; the transmitter pulse circuitry is capable of delivering pulses ranging in width from 20 to 200 microseconds at a pulse repetition rate ranging from 25 to 250 pps. Author

N63-14300 Pennsylvania State U. Ionosphere Research Lab., University Park
ELECTROMAGNETIC NONLINEAR INTERACTION AND REFLECTION FROM A PLANE IONIZED MEDIUM
O. E. H. Rydbeck Apr. 15, 1963 52 p 5 refs
(Contract AF 19(604)-4563)
(Sci. Rept. 183; AFCRL-63-291)

The reflection properties of an isotropic, ionized medium have been formulated for the case where nonlinear effects are produced in the medium by a separate, very powerful "pump" wave of angular frequency ω_p. It is shown that if a primary probing wave of angular frequency ω_o impinges on the disturbed ionized medium at some specified angle, secondary waves of frequencies ω_o, $\omega_o + \omega_p$, and $\omega_o - \omega_p$ are returned. The laws of reflection and refraction for these waves are formulated. The results presented here should be of interest in analyzing the solar corona, ionosphere topside, and meteor trails. R.C.M.

N63-14336 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
PRELIMINARY ORBITAL ELEMENTS OF THE CABIN OF SPUTNIK 4 (1960 ϵ_3) (PREDVARITEL'NYE ELEMENTY ORBITY KABINY IV SOVETSKOGO ISKUSSTVENNOGO SPUTNIKA ZEMLI (1960 ϵ_3))
L. A. Isakovich and A. S. Sochilina London, Ministry of Aviation, Jan. 1963 8 p Transl. by J. W. T. Palmer from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli, v. 24, 1961 p 16-20
(RAE Library Translation 1025)

Orbital elements of the cabin of Sputnik IV (1960 ϵ_3) are given, from June 1960 up to June 1961, on the basis of visual tracking data. Author

N63-14375 Michigan U. Inst. of Science and Tech., Ann Arbor
OPTIMUM CHARACTERISTICS OF SOME MOTION-COMPENSATION SYSTEMS. VOLUME I: THEORY AND APPLICATION OF DOPPLER-INERTIAL SYSTEMS
W. A. Porter and A. Y. Bilal Mar. 1963 45 p 5 refs
(Contract DA-36-039-SC-78801; Proj. Michigan)
(Rept. 2900-371-T(I))

A side-looking radar system employing synthetic-antenna techniques can obtain azimuth resolution finer than that afforded by the radar beamwidth. The capabilities of such systems depend in part on the accurate sensing of vehicle perturbation from a reference path and subsequent phase compensation for this motion. This volume deals with the optimization, for such motion-compensation activities, of a family of doppler-inertial systems. By use of the variational calculus techniques of the Wiener filter theory, functional relationships between optimum system performance and sensor noise errors are developed, and systems with and without dynamically induced errors are compared. Author

N63-14466 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARINER (VENUS '62) FLIGHT TELECOMMUNICATION SYSTEM
J. N. Bryden Jan. 15, 1963 24 p 8 refs
(NASA Contract NAS7-100)
(JPL-TR-32-377) OTS: $2.60 ph, $0.92 mf

Telecommunication flight and ground support equipment for the Mariner spacecraft are discussed. The flight equipment consists of data encoder, command, and RF systems. The ground support equipment includes checkout equipment for the flight equipment and data display and command systems. The telecommunication system provides two-way Doppler, automatic angle-tracking, command, and transmission of scientific and engineering data. Design considerations and operation of the systems used are described. Author

N63-14494 Istituto Universitario Navale, Naples (Italy)
ANALYSIS AND SYNTHESIS OF NONUNIFORM TRANSMISSION LINES OR STRATIFIED LAYERS Technical Note No. 1
G. Latmiral, G. Franceschetti, and R. Vinciguerra Aug. 1, 1962 39 p 8 refs
(Contracts AF 61(052)-36 and AF 61(052)-589)
(RADC-TDR-63-123)

Nonuniform nonlossy or lossy transmission lines (or layers), used as broadband matching or absorbing devices, are studied. When the refraction index n(x) and the propagation constant $Z_0(x)$ are given, the reflection spectrum $\rho_0(\eta) = \rho_0(4\pi/\lambda)$ for $x = 0$ can be always computed by solving numerically a Riccati differential equation. Conversely, not only for $n = \text{const.}$ but even for n(x) real and $\mu = \mu_0$, a tapered transformer can be synthetized starting from a given $\rho_0(\eta)$ spectrum by using the Fourier Transform techniques. For broadband absorbers, the synthetization procedure can be approximately applied, under certain conditions, only to the part of the spectrum which represents the reflection of the matched (lossy) line. Author

N63-14528 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AN/FPS-16 RADAR DATA CALIBRATION TECHNIQUES AT WHITE SANDS MISSILE RANGE
L. J. Mc Manus and R. E. Green Oct. 1962 23 p 2 refs
(SELWS-E-102)

A presentation is made of the complete data-calibration techniques for AN/FPS-16 Radars used at White Sands Missile Range, New Mexico. Certain pertinent local constants are given as well as computation techniques. Author

N63-14579 Radio Corp. of America. Aerospace Communication and Controls Div., Camden, N.J.
INVESTIGATION OF TRANSPORTABLE SEARCH RADAR AND SIF EQUIPMENT Final Report, Apr. 4-Sept. 30, 1962
J. Lauginiger, E. Reid, and R. Morin Apr. 4, 1962 257 p
(Contract AF 19(604)-8020)
(AFCRL-62-700; DSG-62-588-114)

The purpose of the project was to investigate transportable search radar and SIF equipments for application to the purposes of the Mobile ATC/Communication Facility—more commonly known as Augmented Four Wheels. Available equipments were evaluated against a specific performance criterion, and five equipment systems were recommended as applicable to the Augmented Four Wheels program. Each of the five search-radar systems was critically evaluated against Air Traffic Control criteria for the Quick Reaction Posture requirement of the Air Force. Remote-control requirements for the search radar and other subsystems, within the Augmented Four Wheels System complex, were thoroughly investigated. Microwave link equipments were evaluated, and specific performance characteristics were defined for use in the Augmented Four Wheels System. Space and housing requirements for the search-radar subsystem were critically studied, and definitive shelter specifications were prescribed. Author

N63-14591 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-20, VOLUME III FOR THE PERIOD JANUARY 1, 1963 TO FEBRUARY 28, 1963. DEEP SPACE INSTRUMENTATION FACILITY
Mar. 31, 1963 72 p refs
(NASA Contract NAS7-100)
(JPL-SPS-37-20, Vol. III) OTS: $7.60 ph, $2.36 mf

The deep-space instrumentation facility is a precision-tracking and data-acquisition network designed to track, command, and receive data from deep-space probes. It uses large antennas, low-noise phase-lock receiving systems, and high-power transmitters that are stationed around the world at 120-degree intervals. A summary is given of the facility's engineering developments, monitoring system, low-noise systems, ground antennas, planetary radar, the Tiefort Mountain antenna range, and the advanced antenna systems. D.E.R.

N63-14641 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Inst. für Flugfunk und Mikrowellen, Oberpfaffenhofen (W. Germany)
BREITBAND-ANTENNEN [BROADBAND-ANTENNAS]
Th. Heller, H. Öttel, and G. Ulbricht Jan. 1963 93 p 49 refs In German
(DVL-256)

A discussion of broadband antennas includes: (1) radiation of a Hertzian dipole, (2) limits of the wideband of a dipole, (3) a practical design of a broadband dipole, (4) long wire antenna, (5) coil antenna, (6) spiral antenna, (7) a logarithmic periodic antenna system, (8) an optimal wideband polydirectional antenna, and (9) excitation and aerial matching of broadband antennas. Trans. by I.v.L.

N63-14658 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADIO PHYSICS Quarterly Progress Report [Oct. 1–Dec. 31, 1962]
J. V. Harrington and T. F. Rogers Jan. 15, 1963 24 p refs
(Contract AF 19(628)-500)

Radio physics, including radio propagation, communication techniques, plasma physics, communications systems, surveillance techniques, and antennas are covered herein. D.E.R.

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N63-14284 Harry Diamond Labs., Washington, D.C.
A SEMICONDUCTOR NOISE SOURCE
John E. Cronin Feb. 14, 1963 15 p 8 refs
(TR-1099)

A silicon-planar diode producing noise over a broad frequency range (0 to > 25 mc), having a nearly Gaussian amplitude distribution, and excellent uniformity from unit to unit is discussed. This noise, apparently shot noise generated when the diode is operated in the avalanche region, is about 60 db above the thermal noise from an equivalent resistor. The statistical distribution of noise output for 84 diodes is given. Typical variation of the noise output with temperature and internal impedance measurements is presented. A brief discussion of the mechanism of noise generation is also included. Author

N63-14310 Minnesota U. Electron Tube Research Lab., Minneapolis
STUDIES OF PRIMARY ELECTRON SOURCES Scientific Report No. 4, Dec. 1, 1961 to Mar. 1, 1962
W. G. Shepherd and D. E. Anderson Sept. 1962 111 p refs
(Contract AF 19(604)-8381)
(AFCRL-63-5)

Radiotracer studies of the reaction of (BaSr)O cathodes with partial pressure of H_2 are described. The operation of oxide cathodes under heavy pulse current drain shows that the slump in emission is a

consequence of anode contaminants and that impulse heating occurs in the absence of anode effects. An analysis of impulse heating is presented. Photoelectric studies of oxide cathodes and thickness dependence are described. Studies of Al-Al_2O_3-M and Ta-Ta_2O_5-M thin film tunnel-emission devices are described. An upper bound on the ratio of emission current to tunnel current of 1.37×10^{-11} was established for Ta-Ta_2O_5-M systems. An improved measuring technique is described for studies of enhanced electron emission from superconducting field emitters. Author

N63-14327 Motorola, Inc., Phoenix, Ariz.
COMPATIBLE TECHNIQUES FOR INTEGRATED CIRCUITRY Fifth Quarterly Report, 1 May 1962 to 31 July 1962
[1962] 154 p refs
(Contract AF 33(616)-8276)

Efforts to develop process techniques which are necessary for integrated circuit fabrication are reported for both morphological areas and for thin films as applied to semiconducting substrate. Attempts to perfect epitaxial techniques are also reported. A program has been started to develop and fabricate typical circuits which are practical for a wide range of high and low frequency amplifier applications as well as logic circuits. A.R.B.

N63-14418 Services Electronics Research Lab., Baldock (Gt. Brit.)
A NEW DESIGN OF HIGH POWER CERAMIC WINDOW
P. H. Cross *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 26-30 Presented at the Fourth Intern. Cong. on Microwave Valves, the Hague, Sept. 1962 (See N63-14414 10-01)

A high-power ceramic window for the 3-cm band is described which uses a disc of alumina ground to the shape of a biconcave lens. The design offers a good compromise between the requirements for broadband matching, mechanical strength, and good vacuum sealing. The window is matched to a rectangular waveguide by a combination of chokes and shunt inductances which minimizes the electric field normal to the ceramic. The mechanical design of the window is discussed in some detail. Measurements of the cold performance and tests at high powers are also reported. Author

N63-14419 Services Electronics Research Lab., Baldock (Gt. Brit.)
A BAKABLE MAGNET FOR HIGH POWER TRAVELLING WAVE TUBES
A. Thomas *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 31-34 3 refs Submitted for Publication (See N63-14414 10-01)

This paper describes a new type of electromagnet for high-power traveling-wave tubes. The coils are wound on the body of the tube immediately after construction and are able to withstand the temperature of 450° C at which the tube is processed. The design achieves a great saving in weight and power. Author

N63-14501 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
5 REACTANCE 3 TERMINAL PEAKING CIRCUIT Research Report
Leo E. Foley Feb. 28, 1963 30 p 7 refs
(Grant AF-AFOSR-62-295)
(PIBMRI-1119-63)

A five reactive network with three terminals is analyzed on a normalized basis and compared to the simple RC network. Two capacitive elements in the network represent the division of the distributed parasitic capacitance into lumped elements whereas the remaining three elements are physical entities. Values for the reactive elements are selected for three different criteria: (1) critically damped transient response, (2) maximally flat amplitude response, and (3) linear phase response. After the parameters have been selected, the normalized equations for amplitude, time delay, and step response will be derived and plotted for comparative purposes. Pole-zero plots are also drawn to give a more succinct picture of the networks analyzed. The calculations for this report were made with either an IBM 650 computer or a desk calculator. Six significant figures were maintained in the calculations. However, all figures in this report are rounded off to four places. Author

N63-14533 Motorola, Inc. Semiconductor Products Div., Phoenix, Ariz.
RESEARCH AND DEVELOPMENT FOR SURFACE PROTECTION FOR SILICON DEVICES Scientific Report No. 3, June 15-Sept. 14, 1962
H. W. Cooper, H. C. Evitts, S. S. Flaschen, R. W. Rader, and M. A. Hall Oct. 1962 37 p refs
(Contract AF 19(604)-8358)
(AFCRL-63-21)

Wet chemical treatments which can shift surface potential in devices, and alter their current-voltage characteristics to produce higher voltages for specified currents have been demonstrated, the nature of the oxidizing material studied, the effective concentration of chemical in the treatment solution investigated, and the most effective desiccant to preserve the effect of the surface modification has been proposed. Author

N63-14550 Michigan U. Inst. of Science and Tech., Ann Arbor
ON THE USE OF COMPLEX FILTERS
Robert Byron Crane Mar. 1963 57 p 9 refs
(DA-36-039-SC-78801; Proj. Michigan)
(Rept. 2900-368-T)

The system considered is composed of a prefilter and a postfilter operating on a signal in the presence of multiplicative and additive noise. The signal and noise processes are mutually independent and complex-valued. The prefilter and postfilter are linear, time-invariant and complex-parameter filters; that is, the impulse responses are complex-valued functions. The analysis applies to an equivalent system using real-valued signals and filters. Two methods of applying the complex-filtering concept, suitable for communication or radar, are the use of low-pass filters and the use of bandpass filters. A generalized complex postfilter corresponding to four low-pass or two bandpass real filters is optimum. For certain applications, an upper bound is found on the increase in performance gained by the use of a second bandpass filter. When a phase lock on the signal is available, the mean square error can be reduced by a factor of one-half; or the signal-to-noise ratio can be increased by a factor of two. There is no corresponding increase in performance for a generalized prefilter. In fact, a counter-example is found in which a second bandpass prefilter decreases performance. For Gaussian signals, additive noise and no multiplicative noise, a generalized complex postfilter is found that optimizes the estimate of the modulus of the transmitted signal. This new result is not only of interest in the general theory of random processes, but is of considerable practical importance in radar. Author

N63-14552 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham
DEVELOPMENT OF A HIGH CONSTANCY SHORTWAVE DECADE EXCITER STAGE FOR A RANGE OF 1.5 TO 30 Mc/s (DIE ENTWICKLUNG EINER HOCHKONSTANTEN DEKADISCHEN KURZWELLENSTEUERSTUFE FUER DEN BEREICH 1.5...30 MHz)
H. Valdorf and R. Klinger (Standard Elektrik Lorenz) Feb. 1963 20 p 3 refs Transl. from Frequenz (W. Berlin), vol. 14, no. 10, 1961 p 3-11
(TIL/T-5326)

A shortwave exciter stage for a frequency range of 1.5 to 30 mc/s is described. The starting frequency is derived from a crystal-controlled standard oscillator and can be set in decadic steps of 1 kc/s. With some sacrifice in accuracy, any desired frequency within

the 1 kc/s steps can be set as well. The principle of frequency generation is described, and the stability problems of the automatic frequency control system are discussed. The difficulties are pointed out that result in designing exciter stages with signal-to-noise and signal-to-spurious-emission ratios of more than 80 db. Finally the paper deals also with the physical layout of the device which is subdivided into modular units. Author

N63-14553 New Hampshire U. Antenna Systems Lab., Durham
THE COAXIAL DIPOLE PARAMETRIC AMPLIFIER ANTENNA Scientific Report No. 1
Albert D. Frost Dec. 1, 1962 42 p 5 refs
(Contract AF 19(628)-307)
(AFCRL-63-13)

A study has been made of the theoretical and applied problems associated with the design of a parametric amplifier antenna in coaxial dipole form. An analysis is made of the coaxial interior, which serves to provide the resonances needed for parametric amplification, and an expression is derived for the complex impedance seen by the varactor diode in terms of the inner coaxial geometry, the relative electrical length of the output loop, the receiver input resistance, and an adjustable terminating reactance. This latter element permits the tuning of the system for a desired pair of signal and idler frequencies. A completed tuning and bias system for a quarter-wave dipole at 108 mc is shown. Author

N63-14554 Illinois U. Coordinated Science Lab., Urbana
REALIZABILITY OF FUNDAMENTAL CUT-SET MATRICES OF ORIENTED GRAPHS
Wataru Mayeda July 1962 14 p 12 refs
(Contract DA-36-039-SC-85122)
(R-143)

A method is developed that permits determining whether a given matrix is a fundamental, cut-set matrix or an oriented graph. Definitions are reviewed to construct a modified theorem, and some of these definitions are modified to fit the problem. A modified theorem is developed that has many applications in the linear graph theory. D.E.R.

N63-14559 Harry Diamond Labs., Washington, D.C.
RESONANT FREQUENCIES OF CYLINDERS OF ANY DIMENSIONS
George K. Lucey, Jr. Jan. 30, 1963 32 p 11 refs
(TR-1108)

Resonant frequency equations for right circular cylinders of any dimensions were derived to aid in the design of microminiature ceramic piezoelectric filters and transformers. The classical Rayleigh method was modified to include a phantom work term that accounted for energies lost to vibrations in the coupled mode. The equations derived were verified experimentally over a full range of dimension ratios for $BaTiO_3$ cylinders and for a small group of steel cylinders. Author

N63-14566 Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio
TRANSIENT RADIATION EFFECTS ON ELECTRONIC COMPONENTS AND SEMICONDUCTOR DEVICES
D. C. Jones, F. J. Reid, W. E. Chapin, D. J. Hamman, and E. N. Wyler Apr. 19, 1963 116 p 54 refs
(Contract AF 33(657)-10085)
(REIC-26)

This report summarizes the information that was available, before 1962, concerning the effects of nuclear-weapon-burst and simulated-burst radiation on electronic components and semiconductor devices. This work reports only the effects observed in components that are due to gamma rays and/or neutrons of a transient radiation environment. Author

N63-14660 Johns Hopkins U. Carlyle Barton Lab., Baltimore, Md.
ZERO-CROSSING INTERVALS OF RANDOM PROCESSES Technical Report
A. J. Rainal Apr. 1963 149 p 41 refs
(Contract AF 33(657)-11029)
(AF-102)

This report describes a digital system for studying the zero-crossing intervals of random processes. Probabilities and probability densities defined by the zero-crossing points of various Gaussian processes are presented. Probabilities and probability densities defined by the zero-crossing points of a random process consisting of a sine wave plus a Gaussian process are also presented. Finally, probabilities and probability densities defined by the stationary points of a random process consisting of a sine wave plus a Gaussian process are presented. At present none of the probabilities or probability densities can be derived explicitly by analytical methods. The standard deviations associated with the probability densities are also presented. In the case of the Gaussian processes, the correlation coefficients for two successive intervals are presented. The first moments associated with the probability densities are compared with the exact theoretical values. All the other experimental results are compared with theoretical approximations. The statistical dependence between the ith zero-crossing interval and the (i+n)th zero-crossing interval is investigated. Author

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-14262 Aro, Inc., Arnold Air Force Station, Tenn.
AERODYNAMIC DESIGN AND CALIBRATION OF THE VKF 50-INCH HYPERSONIC WIND TUNNELS
James C. Sivells Arnold Engineering Development Center, Mar. 1963 49 p 10 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-62-230)

The theoretical and empirical methods used in the aerodynamic design of the 50-Inch Mach 8 Tunnel (B) and the 50-Inch Mach 10 Tunnel (C) are described. Both tunnels have axisymmetric contoured nozzles. Calibration data concerning Mach-number distribution, boundary-layer thickness, and diffuser performance are also presented. Author

N63-14350 Martin Co., Baltimore, Md.
LUNAR LANDING STUDIES: GROUND SUPPORT EQUIPMENT
A. Grandinetti Mar. 1962 15 p
(Tech. Memo. 29; ER-12305)

Brief investigations of recent studies conducted for the lunar landing rendezvous and shuttle concepts have revealed the need for ground-support requirements very similar to those presented in Apollo Technical Proposal, ER 12020P. The important feature to be emphasized is that the Apollo-proposed basic computer-controlled test and checkout system can be integrated with computer-programed lunar-landing-module test and checkout equipment for launch-site testing. The direct lunar configuration requires ground servicing and testing of its propulsion and landing system. Also, its size and weight require

utilization of larger handling and transportation equipment than required for the rendezvous concept. The use of men in the lunar-landing module for the rendezvous technique will establish the need for a life-support system, guidance and control system, and an automatic and manual in-flight checkout system. Therefore, the ground-support test and checkout objectives for the rendezvous techniques are similar to those proposed for the Apollo Command Module. Author

N63-14400 Toronto U. Inst. of Aerophysics (Canada)
HYPERVELOCITY LAUNCHERS. PART I: SIMPLE LAUNCHERS
I. I. Glass Jan. 1963 139 p 65 refs
(Contract AF 33(657)-7874)
(UTIA-REV-22)

A critical survey is made of hypervelocity launchers and their research applications to reentry physics, hypervelocity impact, gasdynamics and aerodynamics. This portion of the survey (Part I) deals mainly with simple launchers (constant area, single stage, light-gas guns) in order to illustrate some of the basic concepts affecting their design and operation. The effects of counterpressure, boundary layer, bore friction, and gas imperfections are considered. It is noted that there are many outstanding problems associated with the possible acceleration of simple aerodynamic models to velocities of 50,000 ft/sec and beyond. It appears that microparticles might be accelerated to supervelocities of 100,000 ft/sec or more by explosive spray or electrodynamic techniques. Author

N63-14569 Los Alamos Scientific Lab., N. Mex.
LAMPRE PROGRAM Quarterly Status Report for Period Ending Feb. 20, 1963
Mar. 22, 1963 18 p
(Contract W-7405-eng-36)
(LAMS-2875) OTS: $0.50

Progress in the Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) is reported. LAMPRE I (Core II) operations and dynamic analyses indicate satisfactory agreement with predicted power levels. The development of fuel and containers continued. The effects of various fabrication methods on the subsequent performance of tantalum capsules were investigated. Fuel alloys such as Pu-Co-Ce, U-Mn-Pu, and Pu-U-Mn were tested with yttrium and tantalum capsules. Since a previous capsule failure allowed approximately 75 g of Pu-Fe fuel to enter the sodium coolant, samples of sodium were taken to determine if Pu is being carried throughout the reactor system. The data indicate that the Pu contamination has been cleaned up, but that an unexpected high-Fe content exists in the main sodium stream circulating through the core. The phase relationships in the following plutonium alloys systems were elucidated: Plutonium-Carbon-Oxygen, Plutonium-Europium, Plutonium-Lanthanum, Plutonium-Nitrogen, Plutonium-Praseodynium, Plutonium-Scandium, and Plutonium-Yttrium. M.P.G.

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-14258 Southwest Center for Advanced Studies, Dallas, Tex.
HYDROMAGNETIC STABILITY AT A FLUID VELOCITY-DISCONTINUITY
J. A. Fejer Dec. 27, 1962 19 p 7 refs Submitted for Publication
(NASA Grant NsG-269-62)
OTS: $1.60 ph, $0.80 mf

Formal conditions are derived for the stability of a velocity discontinuity at a plane interface between two perfectly conducting, inviscid, compressible fluids, in the presence of uniform magnetic fields. Certain special cases, in which the stability conditions can be simplified, are discussed in detail. Previous results for incompressible fluids are rederived and it is shown that the introduction of a slight compressibility always reduces the stabilizing effect of magnetic fields. In one special case, that of parallel magnetic fields of equal magnitude on two sides of an interface between fluids of identical properties, the analytical form of the stability condition is obtained for arbitrary compressibility. In another special case, that of perpendicular magnetic fields of equal magnitude, the stabilizing magnetic field is determined numerically as a function of the compressibility. In both these special cases the magnetic field required to stabilize an interface continues to increase with the introduction of more compressibility until it reaches a limiting value that is greater by a factor of 2 in the first case, and by a slightly smaller factor in the second case, than the value appropriate to incompressible fluids. Author

N63-14267 Centre National de la Recherche Scientifique, Paris (France)
MÉCANIQUE DE LA TURBULENCE [MECHANICS OF TURBULENCE]
A. Walz, Hans W. Liepmann, and Itiro Tani (Tokyo U.) 1962 p 299-353 refs
(*Its* Colloques Internationaux No. 108)

The present status of theoretical and experimental information on compressible turbulent boundary layers with heat transfer and streamwise pressure gradient is reported. Meritorious attempts of generalizing the approved similarity laws for the mean velocity distribution established on the incompressible field had not yet been successful because of a lack of reliable experimental data from hypersonic tunnel tests. Serious discrepancies between experimental results and theoretical predictions could not yet be removed. An engineering concept of mean velocity and temperature distribution across compressible turbulent boundary layers with heat transfer and pressure gradient is developed. This concept seems to be distinguished by the fact that the number of more or less arbitrary assumptions, present in many approaches to this problem, is reduced to a minimum. This aim appeared realizable by the introduction of a generalized law for turbulent dissipation. With this law in connection with a generalized wall friction law, the integral conditions for momentum and energy form a system of equations, from which two characteristic boundary layer quantities, as a shape parameter of the mean velocity profile and a thickness parameter, may be determined. (In most known approaches, this shape parameter is considered constant). Calculated local and averaged wall friction coefficients for the flat plate flow agree fairly well with reliable experimental data obtained by force measurement. Author

N63-14270 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
INTERACTION BETWEEN SONIC SIDEJETS AND SUPERSONIC DUCT FLOW
R. E. Walker, A. R. Stone, and M. Shandor Dec. 1962 49 p 9 refs
Presented in part at the Symposium on Fluid Amplification at Diamond Ordnance Fuze Labs., Wash., D.C., Oct. 1962
(Contract NOw-62-0604-c)
(Bumblebee Rept. 316)

Data are presented on side forces generated by lateral injection of sonic gas jets into supersonic duct flow. Two primary working fluids are used—a hot gas obtained by catalytic decomposition of 90% H_2O_2 (1845° R) and a cold gas obtained from compressed air (530° R). Constant area supersonic duct flow is provided by

expanding these propellants through an axially-symmetric sharp-corner-throat Clippinger nozzle (exit diameter = 1.00 inch). Two nozzles were used. For one, experimental pressure ratio gives M = 1.92 for cold gas and M = 1.86 for hot gas; for the other, M = 2.90 for hot gas. A variety of ambient-temperature gaseous injectants (H_2, He, He + Ar, N_2, CO_2 and Ar), orifice sizes (0.0625, 0.090, 0.125 and 0.180 inches diameter), and "tailpipe" lengths (0.25, 0.50, 0.75, and 1.00 inches) are studied. Data are reported also for inert hot-gas injection (preburned air or O_2 + trace H_2) into the hot-gas propellant. Injectant and motor pressures are varied and a multiple orifice configuration studied. Author

N63-14278 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A COMPARISON OF EXPERIMENTAL AND THEORETICAL RESULTS FOR THE COMPRESSIBLE TURBULENT-BOUNDARY-LAYER SKIN FRICTION WITH ZERO PRESSURE GRADIENT

John B. Peterson, Jr. Washington, NASA, Mar. 1963 56 p 29 refs
(NASA TN D-1795) OTS: $1.50

Seven theories of compressible turbulent-boundary-layer skin friction were compared with experimental data in order to determine their accuracy. The seven theories used for comparison were those of Van Driest; Wilson and Van Driest; Cope, Monaghan, and Johnson; and Winkler and Cha; and the T' methods of Sommer and Short, Monaghan, and Eckert. The data were obtained from 21 sources, and covered a range of Mach numbers up to 10, and Reynolds number up to 68 × 10^6 at zero heat transfer and 100 × 10^6 with heat transfer. The comparison between the theories and experiment was made on one curve by performing a transformation on the experimental data, and the results showed that the Sommer and Short T' method most accurately matched the experimental data. Curves to aid in the calculation of skin friction by the Sommer and Short T' method are presented. Also presented are two new methods of finding the virtual origin of the compressible turbulent boundary layer. Author

N63-14302 General Dynamics Corp. General Atomic Div., San Diego, Calif.

HYDRODYNAMICS OF HYPERVELOCITY IMPACT

J. M. Walsh and J. H. Tillotson Jan. 22, 1963 47 p 5 refs For presentation at the 6th Hypervelocity Impact Symp.
(Contract AF 29(601)-4759; ARPA Order 251-61; Proj. Defender) (GA-3827)

Numerical techniques have been used to treat the hydrodynamic phase of axisymmetric hypervelocity impact. A series of iron-on-iron impact calculations are discussed in which the projectile velocity and target thickness are each varied over a wide range. An equation-of-state correlation and dimensional analysis lead to a general description of like-metal impacts. An observed late-time asymptotic solution, within the stages of the interaction for which the hydrodynamic approximation is valid, is used to predict the dependence of crater size upon impact velocity. For velocities between about $5(10)^5$ and $2.5(10)^7$ cm/sec, crater dimensions increase as the 0.62 power of impact velocity. Author

N63-14312 Southampton U. (Gt. Brit.)

A PRELIMINARY STUDY OF IONIC RECOMBINATION OF ARGON IN WIND TUNNEL NOZZLES, PART II Technical Note No. 11 No. 11

K. N. C. Bray and J. A. Wilson July 1961 65 p 12 refs
(Contract AF 61(052)-250)
(AASU-185; ARL-222)

A study of electron-ion recombination in the flow of a partially ionized argon through wind-tunnel nozzles is carried out. Effects of conduction, convection, and two-body recombination processes are neglected, but the temperatures of the ions and electrons are allowed to differ. Flow equations have been integrated for a variety of stagnation conditions, and it has been shown that in most cases of practical significance, the flow is far removed from thermal equilibrium. Furthermore, as a result of this effect alone, large differences between the temperatures of the heavy particles and the electrons are predicted. The phenomenon of sudden freezing, peculiar to dissociative flows, is not encountered because of the relatively high electron temperature through the nozzle. Author

N63-14314 Stanford U., Calif.

PROBLEMS UNDERLYING THE NUMERICAL INTEGRATION OF THE CHEMICAL AND VIBRATIONAL RATE EQUATIONS IN A NEAR-EQUILIBRIUM FLOW

George Emanuel Arnold Engineering Development Center, Mar. 1963 76 p 20 refs
(Contract AF 40(600)-930)
(AEDC-TDR-63-82)

The report contains the basis for the method for the precise numerical calculation of one-dimensional nonequilibrium flow of a complex gas mixture through a nozzle. Because of their simple mathematical structure, the vibrational and transformed chemical rate equations can be subjected to numerical analysis. Thus, a detailed analysis of both Runge-Kutta and predictor-corrector integration procedures is performed in which truncation error, stability, and computation speed are examined. The analysis of Runge-Kutta procedures demonstrates that the greater the order of the procedure, the more stable it is. High-order Runge Kutta procedures, unfortunately, also have reduced computation speed. On an overall basis, the commonly employed fourth-order procedure still appears to be the most suitable Runge-Kutta procedure for the integration of the chemical and vibrational rate equations. The basis for the improved technique for controlling the Runge-Kutta integration step size is also established. Author

N63-14338 Massachusetts Inst. of Tech. Engineering Projects Lab., Cambridge

BASIC RESEARCH AND DEVELOPMENT IN FLUID POWER CONTROL FOR THE UNITED STATES AIR FORCE, 1 OCTOBER 1961-31 JANUARY 1962 [First Progress Report]

J. L. Shearer, ed., et al Oct. 31, 1962 113 p 17 refs
(Contract AF 33(657)-7535)
(DSR-8998-1; ASD-TDR-62-513)

This report describes continuing applied research work on problems related to the design and development of high performance hydraulic and pneumatic control equipment for advanced systems. Sustained emphasis on high pressure pneumatic components and systems reflects a desired ultimate objective of employing hot-gas power to operate such systsms. Included in this report are descriptions of work on a Reaction-Jet Servo System and study of friction drag on Reaction-Jet Motors; experimental studies of a flapper valve in a breadboard pneumatic servomechanism; development of transmission line theory; fluid jet relays, and a step-by-step actuator for a pulsed pneumatic information transmission system; cold gas tests of a hot-gas rate gyro; and flow characteristics of small orifices. Author

N63-14379 University of Southern Calif. Engineering Center, Los Angeles

RESEARCH ON RAREFIED GAS DYNAMICS AND PLASMA DYNAMICS [Summary Report, Sept. 1960–Aug. 1962]

Raymond L. Chuan, ed. Sept. 1962 125 p 48 refs
(Contract AF 49(638)-831)
(USCEC-83-101)

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N63-14380 University of Southern Calif. Engineering Center, Los Angeles

HYPERSONIC RAREFIED FLOW NEAR THE LEADING EDGE OF A THIN FLAT PLATE [Summary Report]

R. L. Chuan and J. G. Everton *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 4-11 refs (See N63-14379 10-11)

Theoretical descriptions of the flow field near the leading edge of a flat plate are reviewed, and experimental results for hypersonic rarefied flow near the leading edge are presented. The experiments were performed using a flat plate made of aluminum foil about 0.008 cm thick stretched across a low density free jet. Results are summarized as follows: (1) under slightly rarefied conditions (Knudsen number of the order of 10^{-3}), the general features of the flow field and the induced surface pressure agree reasonably well with second-order weak interaction theory; (2) under rarefied conditions (Knudsen number of the order of 10^{-1}), the measured flow field and the induced surface pressure are not predicted by continuum theories; (3) under both rarefied and slightly rarefied conditions, the induced pressure is related to the absolute density as well as the hypersonic viscous interaction parameter; (4) transition from the free stream to the perturbed flow downstream of the leading edge occurs along a straight line originating at the leading edge; (5) velocity slip is observed at the surface, amounting to as much as 60% of the free-stream velocity; and (6) the skin friction coefficient is of the order predicted by viscous interaction theory. M.P.G.

N63-14381 University of Southern Calif. Engineering Center, Los Angeles

HYPERSONIC LOW REYNOLDS NUMBER WAKES [Summary Report]

R. L. Chuan and J. G. Everton *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 12-18 refs (See N63-14379 10-11)

The wake behind a small sphere, supported by a fine wire stretched horizontally across a free jet, is measured at moderate and low densities. Pitot probe traverses were made in the vertical direction. Under moderate density conditions, the recompression shock in the near wake is barely discernible. Under low density conditions, no distinct shock structure whatsoever is observed around and behind the sphere. These observations are in agreement with those obtained with the flat plate. A feature of the low density wake is the near zero pitot pressure immediately downstream of the sphere which subsequently increases to 42% of the free-stream value at 16.5 diameters downstream. In contrast, the centerline pitot pressure in the moderate density case does not decrease to zero, and rises to only about 20% of the free-stream value. Since the influence of the support wire on the wake structure has not been assessed, these results are considered as preliminary. M.P.G.

N63-14385 University of Southern Calif. Engineering Center, Los Angeles

VISCOUS COMPRESSIBLE AND INCOMPRESSIBLE FLOW IN SLENDER CHANNELS [Summary Report]

James C. Williams, III *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 35-48 refs (See N63-14379 10-11)

The motion of a viscous, compressible, heat-conducting gas in a channel bounded by two non-planar walls, or by a surface of revolution, is determined. The channels are assumed to be slender and the approximate equations of motion are identical with the boundary-layer equations. Solutions are presented for two-dimensional convergent channels with plane walls and these are correlated with the solutions for nonplanar walls. D.E.R.

N63-14386 University of Southern Calif. Engineering Center, Los Angeles

FREE-MOLECULE FLOW FIELD ABOUT A FLAT PLATE [Summary Report

H. T. Yang *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 48-52 refs (See N63-14379 10-11)

The study of the free-molecule flow field over a finite plate shorter than the free-stream mean free path has been completed. The field is determined by applying the discontinuous two-stream molecular distribution function and the line-of-sight principle. The density, velocities, stresses, temperature, and heat fluxes for the entire flow field are obtained and expressed in the form of an infinite series with free-stream speed ratio, and plate to free-stream temperature ratio. The resulting solution is complicated and further research, using Lees' moment method, is necessary to solve the transition flow regime from free-molecule to continuum. D.E.R.

N63-14387 University of Southern Calif. Engineering Center, Los Angeles

SHOCK WAVE STRUCTURE [Summary Report]

H. T. Yang *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 53-54 refs (See N63-14379 10-11)

The various solutions to shock wave structure are discussed. No profile was obtained because the system suggested by Grad is not genuinely parabolic. An attempt is made to derive, with the use of Grad's modification of the thirteen-moment equations, a new profile of the shock. The system singularities upstream and downstream of the shock are now under study and are assumed to be governed by a five-dimensional phase space. Preliminary results indicate that these singularities are not stable. D.E.R.

N63-14393 University of Southern Calif. Engineering Center, Los Angeles

FLOW OVER A BLUNT LEADING EDGE IN A SUPERSONIC PARTIALLY IONIZED FLOW [Summary Report]

Y. Oshima *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 80-84 refs (See N63-14379 10-11)

Oshima's electrogasdynamic blast wave theory is applied to the steady two-dimensional flow over a blunt body. The general equations are reduced to first-order equations for small values of the similarity parameter A and constant energy. The study is intended only as a qualitative verification of the theory. The bow shock shapes for both the theory and the experiment are given. D.E.R.

N63-14449 Space Technology Labs., Inc., Redondo Beach, Calif.

EFFECT OF NOSE BLUNTNESS ON THE TURBULENT HYPERSONIC WAKE

Leslie Hromas and Lester Lees Oct. 1962 80 p 19 refs
(Contract AF 04(694)-1)
(Rept. 6130-6259-KU-000; BSD-TDR-62-354)

The effect of body geometry on the equilibrium turbulent hypersonic wake is examined by computing the wakes behind several bodies with different cone and sphere-cone nose shapes. Typical reentry trajectories at several different altitudes are used for the free-stream conditions. Also, theoretical predictions for the wake growth behind cones are compared with available ballistic range measurements. Author

N63-14451 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham

STUDY BY AN ELECTRICAL ANALOGUE OF LIFTING SURFACES IN AN UNSTEADY FLOW (ETUDE PAR ANALOGIE ELECTRIQUE DES SURFACES PORTANTES EN REGIME INSTATIONNAIRE)

R. Duquenne Jan. 1963 95 p
(TIL/T-5323; ONERA Publ. 98(1960))

An analog method of calculating linearized, unsteady, incompressible flows is described. It generalizes previous publications dealing with the numerical interpretation, by means of the electrical tank, of the lift surface theory in steady flow. The resulting "computer of unsteady lifting surfaces" is described. After verifying the method by comparison with the results of the few theoretical cases which permit rigorous calculation, examples of applications of practical interest are given. Reverse flow theorems provide a means of making an overall check in each particular case. The direct study of transient flows is tackled by means of a simple case (indicial initial lift). The flexibility and rapidity of the method appear to promise generalized application to unsteady, compressible flows. Author

N63-14465 Jet Propulsion Lab., Calif Inst. of Tech., Pasadena

CALCULATION OF TURBULENT BOUNDARY-LAYER GROWTH AND HEAT TRANSFER IN AXI-SYMMETRIC NOZZLES

David G. Ellicott, Donald R. Bartz, and Sidney Silver Feb. 15, 1963 45 p 30 refs
(NASA Contract NAS7-100)
(JPL-TR-32-387) OTS: $4.60 ph, $1.55 mf

The method of Bartz (1954) for computing boundary-layer thicknesses, skin-friction, and heat flux in axisymmetric nozzles has been revised and programed for digital computer solution. The method solves, simultaneously, the integral momentum and energy equations for thin axisymmetric boundary layers. Boundary-layer shape parameters are approximated from one-seventh power profiles of velocity and stagnation temperature, and skin-friction coefficient and Stanton number are evaluated as functions of boundary-layer thickness from the best available semiempirical relations. An IBM 7090 program of the method is available. Author

N63-14474 Wisconsin U., Madison

CYLINDRICAL AND SPHERICAL SHOCK WAVES IN MONATOMIC CONDUCTING FLUIDS Technical Summary Report

Roy M. Gunderson Mar. 1962 24 p 12 refs
(Contract DA-11-022-ORD-2059)
(MRC-299)

A previously derived first-order differential relation between shock strength and channel area variations, obtained when an initially uniform magnetohydrodynamic shock wave of arbitrary strength propagates with constant speed into an ideal, perfectly conducting, monatomic compressible fluid at rest, is integrated numerically to give a shock strength-area relation valid for channels with continuous area variation. Particular area distributions allow a discussion of converging cylindrical and spherical magnetohydrodynamic shocks. It is shown that, near the center, the strengths of such shocks are independent of the applied magnetic field and are given by their gas dynamic values. The usual theory for gas dynamic shock propagation in nonuniform ducts is contained as a special case of the theory presented. Author

N63-14481 ARO, Inc., Arnold Air Force Station, Tenn.

APPROXIMATE EXPRESSIONS FOR BOUNDARY-LAYER THICKNESSES WITH SPECIFIC LONGITUDINAL VELOCITY GRADIENTS FOR APPLICATION TO MAGNETOHYDRODYNAMIC ACCELERATION CHANNELS

Lewis E. Rittenhouse Arnold Engineering Development Center, Mar. 1963 49 p 10 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-24)

Approximate expressions have been derived in closed form for the thicknesses of both laminar and turbulent boundary layers, which include specific longitudinal velocity gradients. Several simplifying assumptions were utilized, of which constant density and constant conductivity in the boundary layer and the assumed flat-plate form for the shear stress at the wall are the most limiting. The equations pertain to the boundary layer on the B-field walls, and the flow is considered to be two-dimensional. The equations have been plotted, and the results indicate that at small values of x and $(\sigma B^2)/\dot{m}$ (the product $x\ (\sigma B^2)/\dot{m}$ is the magnetic interaction parameter), the viscous forces predominate, and the nonmagnetic (conventional) boundary-layer equations describe the thickness. However, at somewhat larger values of x and $(\sigma B^2)/\dot{m}$, the velocity gradient $(dU/dx > 0)$ produces a significant thinning effect on the boundary layer as compared to the flat plate results $(dU/dx = 0)$. When x and $(\sigma B^2)\dot{m}$ are large, previously reported equations which do not incorporate a velocity gradient term are sufficient to estimate the thickness of the boundary layer. Author

N63-14526 Bundesministerium für Verkehr, Bonn (W. Germany)

MESSUNGEN AN ABSAUGEGRENZSCHICHTEN Bericht der Aerodynamischen Versuchsanstalt Göttingen [MEASUREMENTS OF BOUNDARY LAYER SUCTION Report of the Aerodynamic Research Institute of Göttingen]

W. Wuest Düsseldorf, VDI-Verlag GmbH, 1962 37 p 31 refs In German
(*Its* Luftfahrt-Forschungsberichte No. 14)

An approximation method, which applies energy and momentum theorems, is developed for calculating boundary layers with suction. In the method for turbulent boundary layers, empirical laws are set

down for the shear strain of the wall, the energy dissipation function, and the relationship between the profile parameters $H = \delta^*/\theta$ and $\bar{H} = \bar{\delta}/\theta$ where δ^* is the displacement thickness, $\bar{\delta}$ is the energy loss thickness, and θ is the momentum loss thickness. Previously, these laws have been applied only to smooth impermeable walls. Measurements of several porous walls were conducted at various velocities, pressure gradients, and suction volumes to obtain data for boundary layer suction. The following wall types were studied: walls covered with filter paper, walls with longitudinal slots and transverse slots, walls with holes, perforated walls, and walls with continuous fine transverse slots. The wall thickness parameters, the wall shear strain strength were determined by the mechanical integration of the velocity distribution measurements. These calculations, as well as the evaluation of the measurements, were programed for the IBM 650 computer. With the exception of walls with fine transverse slots, a large increase in wall shear strain accompanied an increase in suction volume. This is especially evident when the values of the parameters H are large. Walls with fine transverse slots showed small increase in wall shear strain and the measured curve of the momentum loss thickness agreed with that of the approximation theory of A. Walz. It may be possible to explain the above observations in the light of three-dimensional effects in the case of walls with holes and perforations, or the explanation may be a structural one, i.e., the fineness of the transverse slots in contrast to the much larger holes and the perforations. Laminar boundary layer measurements were conducted and the theoretically predicted occurrence of induced resistances was again proven to be true. Trans. by I.v.L.

N63-14562 Argonne National Lab., Ill.

LOCAL PARAMETERS IN COCURRENT MERCURY-NITROGEN FLOW

L. G. Neal (Northwestern U.) Jan. 1963 76 p 47 refs
(Contract W-31-109-eng-38)
(ANL-6625)

Two instruments were developed which can be used to study the structure of two-phase flow: first, an electrical probe capable of measuring local values of the gas fraction, bubble frequency, and bubble-size spectra; second, an impact probe that can be used to measure the local liquid velocity. These instruments were used to measure local flow parameters in cocurrent mercury-nitrogen slug flow. These results are presented in tabular and graphical form. In addition, a photographic study was made to determine the shape of the individual slugs. The gas fraction and velocity profiles were analyzed by a modification of the variable-density model to include local slip. Results showed that the distribution of the phases is not important in determining the average phase-velocity ratio, and that the average slip is a result of local buoyant forces. The photographic study showed that the structure of mercury-nitrogen flow is much different from air-water flow. The slugs are asymmetric, with the gas rising up one wall and the mercury flowing down the opposite wall. This is a result of the high-surface energy of the mercury and, consequently, nonwetting of the wall. Because of the dissimilarity of flow structures, the correlations derived for air-water flow are not applicable to mercury-nitrogen flow. Author

N63-14563 Argonne National Lab., Ill.

REDUCTION OF VAPOR CARRYUNDER IN SIMULATED BOILING

P. L. Miller (Kansas State U.) and C. P. Armstrong (Ill. U.) Feb. 1963 31 p 1 ref
(Contract W-31-109-eng-38)
(ANL-6674)

This report describes the effect on vapor carryunder in simulated boiling caused by insertion in the flow stream of several different geometric configurations and sizes of wire screens. The effect on vapor carryunder caused by screen location and mesh size is shown to be closely related to other system variables. The relationship among the most significant variables is shown in a series of graphs. Significant reduction of vapor carryunder is achieved under certain conditions. Data verifying a correlation for different system geometries are included. Author

N63-14577 Naval Ordnance Lab., White Oak, Md.

BOUNDARY DISTURBANCES NEAR AN UNDERWATER EXPLOSION BUBBLE

William G. Zuke Mar. 1963 35 p 10 refs
(NAVORD-6877)

High-speed photographs of a number of underwater explosions of 0.2-gram lead azide charges were made. For moderately deep explosions (where the charge depth is one to two maximum bubble radii), water jets above the surface and tubes of air extending down from the surface appeared at points where cables penetrated the surface. Similar phenomena were observed when cables were not present; however, the magnitudes were generally smaller. The occurrence of these phenomena is qualitatively related to Taylor's Instability Theory. If the characteristics of the model explosions of this study are presumed to scale geometrically full-scale nuclear explosions, it can be tentatively concluded that: for moderately deep explosions, atmospheric air flows into the tubes and toward the explosion bubble, and the most likely effect is somewhat increased mixing of radioactive products with the water. Author

N63-14581 Laboratoire de Physique Théorique et Hautes Énergies, Orsay (France)

ON THE THEORY OF CLASSICAL FLUIDS-III

Loup Verlet Mar. 1963 18 p 14 refs
(Supported by AFOAR)

Some higher order approximations to the integral equations obtained with Percus' method are derived and discussed. These approximations deal with the new derivation of approximate integral equations for the pair distribution of classical fluids. It is shown that Percus' method can be used to write explicit integral equations for the two-body correlation function which generalizes the PY and HNC equations. These equations are applied for the case of the hard cube gas; they can also be applied to the case of the lattice gas. D.E.R.

N63-14594 Wisconsin U., Madison

ON THE STABILITY OF A MACLAURIN SPHEROID OF SMALL VISCOSITY

P. H. Roberts (Yerkes Observ.) and K. Stewartson (Durham U., Gt. Brit.) Feb. 1963 33 p 12 refs
(Contract DA-11-022-ORD-2059)
(MRC-373)

The stability of a viscous Maclaurin spheroid is solved asymptotically for small kinematic viscosity, ν. It is shown that, in this limit, the frequency of oscillation, n, with respect to the mode which becomes neutrally stable in the absence of viscosity at the point of bifurcation (where the eccentricity, e, of the meridional section is approximately 0.8127), is

$$n = n_0 + i\frac{5\nu n_0^2}{\phi(e)} + O(\nu) \qquad (1)$$

In the foregoing formula, n_0 denotes the frequency in the absence of viscosity, a the radius of the equational section and $\phi(e)$ a certain function of e which changes sign at $e = 0.8127$ and is positive for smaller values of e. From equation (1) it follows that the Maclaurin spheroid is indeed unstable beyond the point of bifurcation when viscosity is present. Author

N63-14595 Wisconsin U., Madison, Wis.

ON THE MOTION OF A LIQUID IN A SPHEROIDAL CAVITY OF A PRECESSING RIGID BODY Technical Summary Report

P. H. Roberts (Yerkes Obs.) and K. Stewartson (Durham U.) Feb. 1963 45 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-374)

Neglecting magnetic effects, the precession of the mantle of the earth is responsible for hydrodynamic motions in the liquid core because: (1) The velocity of the inner boundary of the mantle along its

normal is nonzero unless the core boundary is a perfect sphere. (2) There is a viscous coupling between core and mantle. (3) There is a magnetic coupling between core and mantle because lines of geomagnetic force thread each. In this preliminary discussion of the problem, we suppose that the core boundary is an oblate spheroid of eccentricity e; it is shown that the relative importance of (1) and (2) depends in an essential way on the value of $R_1 = \omega e^2/\Omega$ where ω is the angular velocity of rotation and $\Omega(\ll\omega)$ is the angular velocity of precession. Since R_1 is almost certainly large for the earth, the present discussion is limited to this case. The motion of the fluid is found by considering an initial value problem in which the axis of rotation of the spheroid is impulsively moved at time $t = 0$; before that time this axis is supposed to be fixed in space, the fluid and envelope turning about it as a solid body. The solution is divided into a steady motion and transients, and, by evaluating the effects of the viscous boundary layer, the transients are shown to decay with time. The steady motion which remains is a circulation with constant vorticity in planes perpendicular to $\underline{\omega}$ and $\underline{\Omega}$. Author

N63-14614 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Aerodynamik, Brunswick (W. Germany)

THREE-DIMENSIONAL BOUNDARY LAYER FLOW

H. Schlichting Dec. 5, 1962 45 p 44 refs Revised version of a paper presented at the Conf. of the Intern. Assoc. for Hydraulic Res., Dubrovnik, Yugoslavia, Sept. 3-7, 1961

(DK-532526; DFL-195; Rept. 62/46 Schl./Db.)

This paper gives a survey on some classic results and deals also with some recent research work on three-dimensional boundary-layer flow. Contrary to the two-dimensional boundary layers, the three-dimensional boundary layers in many cases have a secondary flow normal to the direction of the main flow. This secondary flow is responsible for many peculiar flow phenomena of three-dimensional boundary layers. The following subjects are dealt with to some extent: flow on rotating bodies, as for instance rotating disk, rotating body of revolution in axial flow, and rotating propeller blades; and the flow in curved pipes and in straight diffusers, as well as the so-called corner flow in the rectangular corner between two plane walls. Experimental results are presented for the three-dimensional boundary-layer flow on swept and delta wings and on a body of revolution at incidence. Author

N63-14637 Vidya, Inc., Palo Alto, Calif.

STUDY OF ELECTRICAL BREAKDOWN CONDITIONS IN THE AERODYNAMIC FLOW FIELD OF A HYPERSONIC VEHICLE Final Report, Aug. 1, 1961 - July 31, 1962

Morton Rudin, Boris Ragent, and Charles E. Noble, Jr. Jan. 30, 1963 174 p 39 refs

(Contract Nonr-3581(00); ARPA Order 207-62; Proj. Defender) (Rept. 63-94)

A numerical technique has been formulated for solving the antenna-breakdown equation in the presence of gaseous flow for typical antenna electric field and aerodynamic flow-field configurations. The results of computations for nonflow conditions agree well with existing data. Breakdown conditions were computed for sample cases of antenna type, vehicle shape, and velocity-altitude combinations. The results in air show that, once ambipolar diffusion has been established, increasing the vehicle velocity at a fixed altitude usually increases the breakdown field strength. This increase is found to be caused principally by the increase of gas density near the antenna and, to a much lesser degree, by the effect of the boundary-layer flow velocity in sweeping electrons out of the high electric field regions. Author

N63-14650 California U., Berkeley. Inst. of Engineering Research

ON THE STABILITY OF VISCOUS FLOW BETWEEN ROTATING CYLINDERS; FINITE GAP

Lionel Rintel and Paul Lieber Feb. 1963 14 p 11 refs

(Contract Nonr-222(87))

(MD-63-1)

A mean Taylor number is introduced as a characteristic parameter governing stability of viscous flows between concentric rotating cylinders separated by a finite gap. This parameter is constructed on the basis of the forces causing convection and their mode of contribution to the instability. In particular, for gaps equal to the radius of the inner cylinder considered by Chandrasekhar, it is found that the critical values of this mean Taylor number obey the laws governing the critical Taylor number in the case of small gap. Author

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: 28 Space Radiation.

For related information see: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N63-14244 Pensylvania State U. Ionosphere Research Lab., University Park

LOW FREQUENCY SWEEP GROUP HEIGHT AND POLARIZATION RECORDS Scientific Report [Mar. 5, 1962 to Aug. 22, 1962]

J. D. Hardy Feb. 15, 1963 225 p 3 refs

(Contract AF 19(604)-8012)

(Sci. Rept. (D)-179; AFCRL-63-256)

This report is a presentation of the records obtained during the period March 5, 1962 to August 22, 1962, on a low-frequency group-height and polarization instrumentation covering the swept frequency range of 100 to 1000 kc/s. Included in these data are the preliminary results of a stepped frequency experiment. These appear to be the only such records being obtained in the world at this time. Author

N63-14246 Stanford U. Radioscience Lab., Calif.

SYNCHROTRON EMISSION FROM HIGH-ENERGY ELECTRONS Scientific Report No. 1

Glen L. Hower Oct. 1962 57 p 10 refs

(Contract AF 19(604)-7994)

(SEL-62-149; Tech. Rept. 1403-1; AFCRL-62-1074)

This report reviews the general characteristics of synchrotron emission and summarizes the previous theoretical work. The effect that the various parameters involved in this process have on the intensity, spectrum, and beamwidth of the emission are discussed and the results are presented graphically. General techniques for computing the emission per electron and the total emission from a group of electrons are given. These techniques are discussed with reference to the particular case of emission from electrons trapped in the earth's magnetic field over the geomagnetic equator. The report concludes with a brief discussion of some items of interest in the experimental detection of synchrotron emission. Author

N63-14273 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

WIND FLOW IN THE 80-400 KM ALTITUDE REGION OF THE ATMOSPHERE

George C. Ragsdale and Peter E. Wasko Washington, NASA, Mar. 1963 40 p 54 refs

(NASA TN D-1573) OTS: $1.25

Wind data were obtained in the 80- to 400-km ionospheric region of the atmosphere, and summarized into useful forms for interpretation and deducing wind flow characteristics in these high atmospheric regions for use in space-vehicle-design studies. As

first approximation, the deductions of the wind flow characteristics in the region, based on this study, can be applied to the Cape Canaveral, Florida, area. The most important wind measurement techniques presently used are described. Wind data obtained by the sodium vapor trail method are presented and discussed with respect to wind direction, wind speed, wind vector, and wind shear characteristics. Monthly mean zonal and meridional cross sections for the 30- to 40-degree-latitude belt were constructed for the 80- to 200-km region and interpreted. Additional winds above 200 km from ionospheric drift measurements and from some recent sodium vapor trail measurements are used to deduce wind flow conditions in the 200- to 400-km region. The most important deductions of the wind flow characteristics in the 80- to 400-km region are summarized. Author

N63-14287 Alaska U. Geophysical Inst., College

THE LOWER LIMIT OF LATITUDE (US SECTOR) OF NORTHERN QUIET AURORAL ARCS, AND ITS RELATION TO Dst(H)

S. I. Akadofu and S. Chapman Repr. from J. Atmospheric and Terrest. Phys., v. 25, 1963 p 9-12
(NASA Grant NsG-201-62)

A study is made of the relation between the lower limit of latitude attained by quiet arcs in the U.S. sector during IGY, 16 magnetic storms, and the intensity of the magnetic field produced by the ring current. It is shown that the equatorward shift of quiet arcs is closely related to the growth of the ring current. Author

N63-14322 Boston U., Mass.

A STUDY OF TEKTITES

Gerald S. Hawkins Repr. from J. Geophys. Res., v. 68, no. 3 Feb. 1, 1963 p 895-910 62 refs
(NASA Grant NsG-21-59)
(Its Astron. Contrib., Ser. I, No. 9)

A three-year research program at Boston University is described. A field survey was made in Texas, Georgia, Martha's Vineyard, and southern states along the Jackson formation. Sandstone taken from the tektite fields was fused into a glass by means of a solar furnace with an energy expenditure of 1.6×10^{11} ergs g^{-1}. Although solar furnace glass resembled tektite material in its gross characteristics, there were notable differences in the magnetic domains and in the bubble content. Ablation experiments were carried out using tektite material in a plasma jet. It was found that with a Mach number of 0.47 the flange, so characteristic of flight forms, did not form as a stable structure. The new evidence has been combined with existing data in a logic table to assess the various theories of the origin of tektites. Arguments and interpretations are given on the basis of this table to show that tektites are produced as splashes of fused material from terrestrial craters formed by impact with a meteorite or asteroid. Author

N63-14323 Pennsylvania State U. Ionosphere Research Lab., University Park

THE RECOMBINATION COEFFICIENT OF THE NIGHTTIME F LAYER

John S. Nisbet and T. P. Quinn Repr. from J. Geophys. Res., v. 68, no. 4, Feb. 15, 1963 p 1031-1038 21 refs
(NASA Grant NsG-134-61)

An investigation of recombination in the nighttime F region is described in which use was made of electron-density profiles of the region up to the maximum of the layer obtained from ionosonde records. Several models of the region above the maximum were compared to reconstruct the entire profile. Profiles of the F layer were reconstructed for several successive hours during the night. The recombination coefficient was then assumed to vary as a function of height in accordance with the scale height of either molecular oxygen or molecular nitrogen, and values of the recombination coefficient at 300 km were calculated. Marked percentage changes of β with temperature, of the same order as current estimates of the changes in neutral-particle density with temperature, were observed. Estimated values of β as a function of temperature are presented. Author

N63-14447 Armour Research Foundation, Chicago, Ill.

INVESTIGATION OF TECHNIQUES FOR THE REMOVAL OF ELECTRONS IN THE UPPER ATMOSPHERE Final Report, Dec. 1, 1961-Dec. 31, 1962

Robert D. Sears [Feb. 1963] 24 p 16 refs Submitted for Publication
(Contract AF 19(628)-316)
(ARF-A204-3; AFCRL-63-52)

Approximate conditions are defined which allow calculation of maximum mean electron energy at equilibrium for the undisturbed or slightly disturbed daytime ionosphere. Comparison of these maximum values with a measured electron energy of 0.15 ev at 40 km shows agreement within a factor of 2, which may be accounted for by the disturbed condition of the ionosphere during the measurement. The range of maximum permissible electron energies lies 1.2 times ambient at 30 km to 42 times ambient (0.74 ev) at 90 km. A method is outlined whereby one parameter among the set, equilibrium electron energy, energy loss characteristic time, or electron removal characteristic time, can be determined if the other two can be found experimentally and if the mean source energy of the electrons is known. Thus radio measurement techniques or rocket probes can be used to relate temperature measurements and electron-density measurements through a reaction model based upon estimation of characteristic times of competing processes. Author

N63-14525 New York U. Coll. of Engineering, N.Y.

PROBABLISTIC DYNAMICS Final Report

Max A. Woodbury Apr. 30, 1959 *In its* Probablistic Dynamics Final Report June 30, 1962 p 21-28 (See N63-14523 10-21)
(Contract AF 19(604)-3490)
(AD-216-319; AFCRC-TR-59-247)

The equations developed to measure the growth of uncertainty of the initial state of the atmosphere with time are applied to real data. Using two series of 500-mb level observations at Columbia, Missouri, and Washington, D.C., the equations which relate the space spectrum to the time spectrum were solved. However, a large number of impossible negative energy spectral points were obtained, and a recomputation using very narrow filters on the time spectrum did not materially improve this situation. Next, data from three nearly equispaced stations were used to test the effects of the space relationship. The properties of the statistical estimators were found to depend upon the positive-definite nature of the covariance matrix of the estimates of the observable spectra. A program to compute a pseudoinverse of a covariance matrix of a nonpositive-definite character has been written, but not tested as yet. M.P.G.

N63-14540 Johann Wolfgang Goethe U. Inst. für Meteorologie und Geophysik, Frankfurt am Main (W. Germany)

ANNUAL REPORT NO. 3, PARTS I AND II

Hans-Walter Georgii and Erich Weber Dec. 1962 35 p 20 refs
(Contract AF 61(052)-249)
(AFCRL-63-404)

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1. THE CONCENTRATION OF CHEMICAL TRACES IN GLACIER-ICE Hans-Walter Georgii and Erich Weber 8 p 8 refs (See N63-14541 10-12)
2. FURTHER INVESTIGATION ON TROPOSPHERIC WASH-OUT Hans-Walter Georgii and Erich Weber 23 p 12 refs (See N63-14542 10-12)

N63-14541 Johann Wolfgang Goethe U. Inst. für Meteorologie und Geophysik, Frankfurt am Main (W. Germany)

THE CONCENTRATION OF CHEMICAL TRACES IN GLACIER-ICE

Hans-Walter Georgii and Erich Weber *In its* Annual Report No. 3, Part I, Dec. 1962 p 1-8 8 refs (See N63-14540 10-12)

The report deals with the results of chemical analyses of melted ice samples from an Austrian glacier and from an Arctic island. The concentration of the different components in the ice samples from Austria is very low compared with the concentration of the same ions in freshly fallen precipitation. This discrepancy can most certainly be explained by the mechanism of the formation of glacier grains. The series of ice samples collected at the Arctic island covering the period 1920 to 1960 does not show any increase of the SO_4-concentration with time. Author

N63-14542 Johann Wolfgang Goethe U. Inst. für Meteorologie und Geophysik, Frankfurt am Main (W. Germany)

FURTHER INVESTIGATIONS ON TROPOSPHERIC WASH-OUT

Hans-Walter Georgii and Erich Weber *In its* Annual Report No. 3, Part II, Dec. 1962 p 1-23 12 refs (See N63-14540 10-12)

The following report summarizes recent research on the budget of trace substances in cloud water and rainwater conducted at three sampling stations in different altitudes. Further results on the importance of gaseous traces for precipitation chemistry as well as on simultaneous records of total concentration of trace substances, pH-value and radioactivity during individual rainfalls are communicated. Author

N63-14543 Norwegian Meteorological Inst., Blindern

VARIATIONS OF ATMOSPHERIC OZONE AND ADVECTIONS IN NORTHERN NORWAY

Johan G. Figenschau (Oslo U.), H. Solberg (ed.) (Oslo U.), and R. Fjørtoft (ed.) Repr. from *its* Meteorol. Ann. (Oslo), v. 4, no. 18, 1963 p 463-538 19 refs

Available from Morten Johansens Boktrykkeri, Oslo: 21.00 Kr.

On the basis of the great dissimilarities which may occur in the total ozone of the atmosphere above a particular weather station from one year to another, an inquiry has been made into what meteorological conditions may have caused the variations in the total ozone above the city of Tromsø during the five-year period 1952 to 1956. A few ozone readings taken at Longyearbyen, Svalbard (Spitzbergen) have been included for the discussion of some aspects of the ozone fluctuations. The meteorological conditions are presented by way of observations made at Tromsø of the meteorological parameters at 100 mb, the tropopause, 600 mb, and ground level. It appears as if the ozone dissimilarities are to a great extent dependent on advections in the upper troposphere and the lower stratosphere. Variations in the northern frontal systems are also indicated. Author

N63-14544 Paris Observatory, Meudon (France)

CARTES SYNOPTIQUES DE LA CHROMOSPHERE SOLAIRE ET CATALOGUES DES FILAMENTS ET DES CENTRES D'ACTIVITE, VOLUME 4, FASCICULE 1 [SYNOPTIC MAPS OF THE SOLAR CHROMOSPHERE AND CATALOGUES OF FLARES AND SUNSPOTS, VOLUME 4, ISSUE 1]

M.-J. Martres et al 1962 105 p Commemorating the Annee Geophys. Intern. (IGY) 1957 (2nd Semester) and 1958 and the Année de Coop. Géophys. Intern. 1959 Includes Rotations No. 1389 to 1421 of July 6, 1957 to Dec. 23, 1959 In French

(Supported by UNESCO)

Synoptic charts of the solar chromosphere are presented along with catalogs of flares and sunspots. For each rotation of Carrington, the following are included: (1) synoptic charts representing the active centers and solar streams, (2) a catalog of solar streams observed in the course of the rotation, with an identification of recurring streams, and (3) a catalog of active centers observed in the course of rotation, with an indication of their recurrence and evolution. The charts and catalogs are based on spectroheliograms H_α, K_{1v} and K_3 from the Meudon Observatory, filtergrams from the Haute-Provence Observatory, and spectroheliograms from observatories in Italy, Crimea, the South Indies, and Mount Wilson in California. M.P.G.

N63-14606 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.

DISPERSION OF RAYLEIGH WAVES ALONG THE MID-ATLANTIC RIDGE Research Note

Henry A. Ossing Jan. 1963 13 p 10 refs

(AFCRL-63-201)

Comparison of the characteristic dispersion curves of Rayleigh waves from earthquakes occurring in five sections of the Mid-Atlantic Ridge, whose travel paths to Weston include basin and basin plus ridge paths, is made with a theoretical curve taken from Dorman's Case 8099 and Dorman and Oliver's Case 8341 to determine the effect of the Ridge on the dispersion of Rayleigh waves. Small increments of variations between the averaged dispersion curves traversing only basin paths and those traversing basin and ridge paths in the significant period range 18 to 25 seconds are suggestive but not conclusive. Thus the investigation of events having longer travel paths is necessary. Author

N63-14620 Stanford Research Inst., Menlo Park, Calif.

PROJECT GNOME. INTERMEDIATE RANGE EARTH MOTION MEASUREMENTS Final Report

L. M. Swift Mar. 21, 1963 80 p 5 refs

(PNE-111F) OTS: $2.00

This project was designed to obtain data on Gnome shot (3.1 ± 0.5 kt detonated at a depth of 366 meters in Salado halite, near Carlsbad, New Mexico) that would improve the capability of extrapolation and prediction criteria for earth motion at long ranges from underground shots, primarily to permit evaluation of damage capability to surface and subsurface off-site structures. This test demonstrated that predictions of free field earth motion at intermediate ranges based on standard scaling laws are satisfactory for range settings in a medium such as halite even when the scaling ratio is large. Author

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-14399 Allied Research Associates, Inc. Aracon Labs., Concord, Mass.

SYNOPTIC INTERPRETATIONS AND HEAT BALANCE DETERMINATION FROM TIROS II RADIATION DATA Scientific Report No. 1 [Jan. 1-2, 1961]

Raymond Wexler Jan. 4, 1963 28 p 5 refs

(Contract AF 19(628)-429)

(AFCRL-63-247)

The radiation data of Tiros II are analyzed from the point of view of synoptic interpretation and heat balance determination. Because of changing calibrations in Channel 4 (8 to 30 μ), it was found necessary to make empirical and theoretical corrections for the determination of heat balance. Observed limb-darkening effects were greater than those deduced theoretically. Patterns of radiation in the 8 to 13μ region, as measured by Channel 2, are analyzed over eight successive orbits for 1 and 2 January 1961. Comparisons are made with the surface weather map during the period. Evidence is found for cloudiness bands connecting the intertropical convergence

zone (ITC) with disturbances at high latitudes. Mean latitudinal temperatures, as determined from Channel 2, show a sharp dip at the ITC which shifts from 0° to 5° N on 1 November 1960 to 0° to 5° S on 2 January 1961; a peak of temperature occurs in the northeast trades at 10° to 15° N in January. Temperatures are relatively constant between 20° to 40° S in January, indicative of the larger latitudinal spread of the summer subtropical high. For the heat balance determination of 1 and 2 January 1961, it was found that the earth was losing heat north of 5° N. The sharpest gradient in net incoming radiation occurred just south of the ITC. Author

N63-14520 Columbia U. Inst. of Flight Structures, New York, N. Y.

UPPER AND LOWER BOUNDS IN PROBLEMS OF MELTING OF SOLIDIFYING SLABS

Bruno A. Boley Oct. 1962 28 p 9 refs

(Contract Nonr-266(20))

(Tech. Rept. 23; CU-23-62-ONR-266(20)-CE)

The problem studied is that of a slab, heated in an arbitrary manner on one face and insulated on the other, which melts (or solidifies), the material being allowed to remain stationary after change of phase. Variable material properties are taken into account. After preliminary general considerations, it is shown that the solution to the stated problem is unique. It is then proved that higher rates of melting and higher temperatures will result from certain combinations of the magnitude of the applied heat input and of a fictitious heat source traveling with the solid-liquid interface. From this result, a method is developed for the construction of upper and lower bounds to the solution of the problem; an example is also presented. it is also shown that, under the same arbitrary heat input, the rate of melting in the present problem is always lower than that in the companion problem in which the material is instantaneously removed after change of phase. Author

N63-14561 Atomics International, Canoga Park, Calif.

THERMAL NEUTRON TRANSMISSION THROUGH CADMIUM-COVERED FOILS

J. A. DeJuren and R. K. Paschall Mar. 15, 1963 14 p 3 refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-7770) OTS: $0.50

The transmission of thermal neutrons through cadmium covers as a function of cadmium thickness was measured in a graphite stack at various heights above the thermal column of the AE-6 reactor. An aluminum disk containing slots for the foils was rotated in the center graphite stringer position. Foils of 40% indium and 60% tin, 0.005 in. thick, were used as detecting foils and were beta-counted. As the thermal flux incident on a cadmium cover is depressed relative to the flux incident on a bare foil, a foil with a thick cadmium cover on one side only was used for the zero thickness measurement and its activity was doubled. The resultant thermal activities as a function of cadmium thickness were consistent with the exponential integral $2E_3(\Sigma_a d)$, and a value of 2514 barns was used for the absorption cross section of cadmium. For $\tau = 0$, $2E_3(\tau) = 1$. Author

N63-14572 Boeing Co. Transport Div., Renton, Wash.

HEAT INTERCEPT COOLING SYSTEM FOR THE SUPERSONIC TRANSPORT

George C. Newell and George B. Evelyn [1962] 27 p 4 refs

A concept of cooling passenger and crew compartments for the supersonic transport utilizes air flowing outwardly through the wall insulation to prevent aerodynamic heat from passing through the wall. This cooling principle, called the heat-intercept system, has been successfully tested on a full-size aircraft body section. Aerodynamic heat flow into the cabin can be reduced by 80% when 1.5 lbs/hr/ft^2 is allowed to pass through the wall under conditions where the outside skin temperature is 500° F. Because of its simplicity, light weight and reliability, the heat-intercept system is ideally suited for application to the supersonic transport. Author

N63-14573 Aerojet-General Nucleonics, San Ramon, Calif.

ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. HEAT TRANSFER AND FLUID FLOW STUDIES WITH BOUNDARY LAYER TURBULENCE PROMOTERS

N. Kattchee and W. V. Mackewicz Feb. 1963 61 p 20 refs

(Contract AT(10-1)-880)

(IDO-28578) OTS: $1.50

This report describes a detailed investigation of the heat-transfer and fluid-flow characteristics of fuel elements designed for the second core of the ML-1 gas-cooled reactor. Boundary-layer-turbulence promoters were placed on the heat-transfer surfaces of the 19 pins of a fuel element; and heat transfer fluid flow, mass transfer, and flow visualization tests were performed. Local, as well as average, results were obtained. By varying the pitch and the height of the turbulence promoters, it was shown that the heat-transfer rate can be increased by approximately 100% without significantly changing pumping power or the overall geometry of the fuel elements. These results were produced by locally separated boundary-flow conditions in the vicinity of the turbulence promoters. Author

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.

For related information see: 16 Life Sciences.

N63-14305 Washington U. Coll. of Engineering, Seattle

MAN-COMPUTER INTERFACE STUDY

David L. Johnson and Arthur L. Kobler June 1962 43 p 18 refs

(Contract AF 49(638)-1070)

A study and analysis are made of the existence and placement of the human-computer interface in digital-computer solutions of mixed-system problems. Much of the work during this first contact period has been devoted to the definition of critical dimensions in the interface fixants in order to determine the structure and direction of more specific research. Three major areas are being dealt with specifically: (1) attitudes toward computers, (2) machine learning techniques, and (3) memory and meaning operation and organization for association and retrieval. These three areas are being examined with respect to their potential in moving or fixing the man-machine interface in various types of problems. The work is interdisciplinary, being carried out by engineers and a clinical psychologist. Author

N63-14489 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio

SOME ASPECTS OF PROBLEM SOLVING: SEQUENTIAL ANALYSIS OF THE DETECTION OF EMBEDDED PATTERNS [Final Report]

Paul A. Kolers and Donald L. Zink Dec. 1962 18 p 18 refs

(AMRL-TDR-62-148) OTS: $0.50

Performance on a forced-choice target detection task was examined in terms of the sequences of responses subjects made. In about 50 percent of all cases resulting in a correct detection, subjects made a specific error immediately before identifying the correct target. In about the same percentage of cases of failure to detect the correct target, that same error was given instead of the correct response. Practice on the task resulted in a general improvement in speed and number of correct detections, and also in a change in the proportional occurrence of certain errors; the most likely but wrong response (X) was given more often, and the least likely and

wrong response (Z) was given often, with practice. In addition, while the best 25 percent of the subjects detected more targets to criterion and detected them more rapidly than the poorest 25 percent, the proportional occurrence of specific response patterns was approximately the same in the two groups for the targets that were correctly detected. Scaled similarity of the alternatives was an important determinant of errors, while perceived orientation had no relation either to perceived similarity or to the response sequences. Author

N63-14574 Human Sciences Research, Inc., Arlington, Va.
FEASIBILITY FOR RESEARCH APPLICATION OF VISUAL ATTACHMENTS FOR DYNAMIC FLIGHT SIMULATORS. REPORT NO. 2: REQUIREMENTS AND STATE-OF-THE-ART EVALUATION
John A. Whittenburg and James E. Wise Feb. 1963 125 p 56 refs
(Contract FAA/BRD-401)
(HSR-RR-62/10-Mk-X)

This report identifies human-factors-research requirements for visual attachments to dynamic flight simulators, evaluates the state-of-the-art in visual simulation techniques for meeting these requirements, and discusses, within the context of a research and development cycle, alternative study settings (e.g., laboratory, simulation, and field) for investigating different types of human-factors problems associated with visual cues and pilot performance. Current research problems dealing with visual cues and pilot performance during terminal flight and ground phases are grouped according to the nature of the task involved and types of variables related to the performance of these tasks. Three categories were used for grouping current problems: (1) detection identification requirements, (2) guidance requirements, and (3) pilot-related variables. Author

N63-14648 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
HUMAN PERFORMANCE IN A SIMULATED SHORT ORBITAL TRANSFER [Final Report]
Duane F. Kasten Dec. 1962 43 p 4 refs
(AMRL-TDR-62-138) OTS: $1.25

Human performance was measured in a simulated short-range, coplanar orbital rendezvous task. Orbital conditions and vehicle dynamics were programed on an analog computer. Two systems of vehicle control and one system of information display were investigated. Performance criteria included impact velocity, fuel consumption, and transfer time required. Comparisons were made between control systems and between initial conditions. Subjects' performance was better with an orthogonal-axes, thrust-control system than with a pitch attitude and one-axis thrust-control system. The simulated direct-vision target display was found to be marginally acceptable. Suggestions about control systems and rendezvous techniques are included in the report. Author

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N63-14255 Bureau of Mines. Albany Metallurgy Research Center, Ore.
A METAL DIAPHRAGM APPARATUS FOR MEASURING VAPOR PRESSURES. VAPOR PRESSURE OF ARSENIC (III) OXIDE
F. D. Stevenson and C. E. Wicks 1963 23 p 16 refs
(BM-RI-6212)

A metal-diaphragm pressure-relay system was constructed to measure vapor pressures of the metal halides, oxyhalides, and other substances at temperatures up to 700° or 800° C. The vapor pressure of arsenic (III) oxide (As_2O_3) was determined to verify the reliability of the apparatus for such measurements. The data for the liquid As_2O_3 (282° to 483° C) are represented by the equation,

$$\log P_{mm} = 6.875 - 2{,}929/T,$$

from which the normal boiling point was calculated to be 461° C. The heat of vaporization calculated from this equation was 13.40 ±0.09 kcal/g mole As_4O_6 and is essentially constant over the interval studied. The melting point of the octahedral arsenic (III) oxide was determined to be 278° C from the intersection of the solid and liquid vapor pressure curves. A thermal analysis apparatus is also described by which melting and transition temperatures could be checked by a method independent of vapor pressure data. The melting points of the monoclinic and octahedral forms were determined to be 314.4 ±1.4° C and 278 ±5° C, respectively. Author

N63-14265 Naval Research Lab., Washington, D. C.
A RADIAC CALIBRATOR FOR SHIPBOARD USE
S. G. Gorbics and A. E. Nash *In its* Report of NRL Progress Oct. 1962 p 1-7 3 refs (See N63-14264 10-23) OTS: $1.25

A prototype instrument intended for use on shipboard for the calibration of radiac instruments has been designed and built at the Naval Research Laboratory. A continuous field variation from 0.25 mr/hr to 500 r/hr with a total source motion of 4 inches was achieved through the use of mercury as the attenuating medium. Rapid calibration of gamma radiation-monitoring instruments is facilitated by calibration disks which provide reproducible positions of the 30 curie Cs^{137} source for each range of each type of instrument. Eight units of a commercial version of this calibrator, designated as the Radiac Calibrator TS-1216B/UD, have been produced and placed into use. Testing, loading, and calibration of these units was done at the Naval Research Laboratory. Author

N63-14276 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR THE MEASUREMENT OF TRANSPORT PROPERTIES OF POLAR SEMICONDUCTORS
Martin M. Sokoloski and Felix E. Geiger Washington, NASA, Mar. 1963 14 p 21 refs
(NASA TN D-1695) OTS: $0.50

The existing theoretical and experimental data on the mobilities of polar semiconductors are reviewed briefly, with special emphasis on PbTe because of its technical importance in thermoelectric power generation. Theoretical calculations on optical and acoustical mode scattering are compared with experimental data. Experimental evidence indicates that the effects of changing statistics and possible changes in the effective mass as a function of temperature may hide the true dependence of the mobility on temperature. Therefore, a new series of measurements of transport properties, such as the Hall coefficient and resistivity, is suggested; and apparatus to measure these properties in the range from 80° to 850° K is described. The apparatus consists of a cryostat in which the sample can be cooled to liquid-nitrogen temperatures, and then heated and held at any desired intermediate temperature. A detailed description is given of the experimental apparatus: the cryostat, vacuum system, and sample holder assembly. The transport properties (Hall constant, resistivity, etc.) can be measured by the usual d.c. method; and, alternatively, an a.c. bridge can be used for direct resistance determination. Author

N63-14277 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A DYNAMIC THERMAL VACUUM TECHNIQUE FOR MEASURING THE SOLAR ABSORPTANCE AND THERMAL EMITTANCE OF SPACECRAFT COATINGS

W. B. Fussell, J. J. Triolo, and J. H. Henninger Washington, NASA, Mar. 1963 30 p 9 refs
(NASA TN D-1716) OTS: $1.00

The various optical and thermal methods of measuring solar absorptance and thermal emittance are discussed in some detail. The thermal vacuum technique used by Goddard Space Flight Center is described. The apparatus consists of: (1) a high vacuum chamber with inner walls cooled by liquid nitrogen, and (2) a powerful carbon arc lamp. In operation, a test sample coated with the material under investigation is suspended in the vacuum chamber facing a window in the chamber wall. A thermocouple in the test sample records its temperature. The sample is illuminated by the arc lamp, and its rise in temperature is recorded to above ambient temperature. While the arc lamp is on, its intensity of illumination is measured. The arc lamp is then turned off, and the sample's fall in temperature is recorded. From the sample's temperature-time data and the intensity of the arc lamp, the solar absorptance and thermal emittance can be computed to within ±7 percent. Author

N63-14286 Union Carbide Nuclear Co., Oak Ridge, Tenn.

INSPECTION OF BERYLLIUM CHIPS BY NONFILM RADIATION IMAGING

R. E. Cofield Mar. 25, 1963 23 p 4 refs
(Contract W-7405-eng-26)
(Y-1403) OTS: $0.50

Consideration of nonfilm radiation imaging methods for the detection of foreign inclusions in beryllium chips has indicated that X-ray fluoroscopy is a suitable technique. Fluoroscopy can easily detect 1/16 by 1/16 by 0.004-inch-thick aluminum in 3/4-inch-thick layers of Be chips, and is superior to imaging on an X-ray-sensitive television camera tube. A fluoroscopic inspection cabinet was designed and utilized for the batch inspection of beryllium chips in machine shop and chip salvage areas, and a system has been conceived for the continuous inspection of large quantities of chips, utilizing fluoroscopic image amplification. This system is possibly suitable for complete automation by utilizing electronic recognition of debris and automatic separation of rejected chips from acceptable material. Author

N63-14320 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)

THE BEHAVIOR OF THE "FOKKER BOND TESTER" ON DOUBLE LAP JOINTS

J. B. de Jonge Mar. 1962 19 p 3 refs
(Supported by Netherlands Aircraft Development Board)
(NLR-TN M.2098)

In this report the analysis of the response of the "Fokker Bond Tester" on single lap joints, given in NLR Report M.2080, is extended to the case of double lap joints. Theoretical results are compared with measurements, indicating a good agreement between theory and experiment. Author

N63-14384 University of Southern Calif. Engineering Center, Los Angeles

VACUUM GAGE CALIBRATION SYSTEM [Summary Report]

J. G. Everton and F. O. Smetana *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 31-35 refs (See N63-14379 10-11)

A vacuum gage calibrator, consisting of a large vacuum reference chamber and an electric timer and counter that allows discrete calibration points, has been developed to accurately measure gas pressures in the range of 10^{-3} to 25 torr. Its design, theory, and applications are discussed. D.E.R.

N63-14401 Southampton U. (Gt. Brit.)

THE WIND TUNNEL BALANCES IN THE LARGE LOW SPEED TUNNEL AT SOUTHAMPTON UNIVERSITY

P. O. A. L. Davies, R. W. Dyke (Follands Ltd., Gt. Brit.), and C. A. Marchaj Dec. 1962 42 p 2 refs
(AASU-208)

Three independent balance systems, composing a weighbeam balance, a strain gage balance, and a cantilever spring balance are installed in the low-speed wind tunnel at Southampton University. A description of each balance system is given, together with its calibration and performance. Author

N63-14423 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Inst. für Angewandte Gasdynamik, Aachen (W. Germany)

ENTWICKLUNG VON MESSGERÄTEN FÜR DAS VERSUCHSPRUFWESEN IN DER LUFTFAHRT. 1. MESSGERÄTE FÜR KURZFRISTIG ARBEITENDE ÜBER-SCHALLWINDKANÄLE [DEVELOPMENT OF MEASURING AIDS FOR TESTS AND EXPERIMENTAL TECHNIQUES IN AERONAUTICS. 1. A MEASURING AID FOR AN INTERMITTENT SUPERSONIC WIND TUNNEL]

A. Heyser Oct. 1962 50 p 6 refs In German
(DVL-182)

A review is presented of developmental work in measuring devices for intermittent supersonic wind tunnels, conducted by the department of applied gas dynamics of the German Research Institute of Aeronautics and Astronautics. Emphasis is placed on: multicomponent built-in balances with strain gages; adjusting devices; multichannel-pressure measuring equipment with inductive pressure gages; a miniature pressure gage; a pressure selector switch; and the automatic directing of the testing method. Trans. by I.v.L.

N63-14435 General Mills Electronics Group, Minneapolis, Minn.

A STUDY OF HIGH ALTITUDE WATER-VAPOR DETECTORS Final Scientific Report [May 1-Dec. 31, 1962]

S. Rohrbough Mar. 31, 1963 32 p 5 refs
(Contract AF 19(628)-483)
(Rept. 2365; AFCRL-63-407)

This report describes the research and engineering required to prepare a sampling system for making water-vapor and index of refraction measurements in the atmosphere. It covers the instrumentation, equipment testing, flight description, and results of the flight, and includes conclusions and recommendations. Author

N63-14443 Vermont U., Burlington

USE OF AN IONIZATION GAUGE AS THERMAL CONDUCTIVITY VACUUM GAUGE

A. D. Crowell and E. L. Foley 1963 3 p 2 refs Submitted for Publication
(NASA Grant NsG-241-62)
OTS: $1.10 ph, $0.80 mf

A procedure by which the ionization gage in many vacuum systems can be made to function as a thermal conductivity gage is described. The ion gage filament, when operated well below incandescence, was found to constitute an effective heating element for a Pirani gage. Two types of ionization gages were tested in simple bridge circuits, and the critical transition region from 10^{-1} to 10^{-4} torr was readily observed with either gage. This pressure change produced a change of about 10 millivolts in the potential difference across the detector with gage filament currents of a few hundred amperes. The off-balance reading from the detector (either a 10-millivolt voltmeter or a recording potentiometer) was easily followed as a function of pressure. M.P.G.

N63-14448 Manchester U. (Gt. Brit.)

THE DEVELOPMENT AND DESIGN OF A POLARIMETER FOR LUNAR STUDIES Technical Note No. 1

David Clarke Nov. 1962 51 p 11 refs
(Contract AF 61(052)-378)
(AFCRL-63-405)

Some of the difficulties of measuring the usually small degree of polarization of astronomical objects are described. The equations necessary for the evaluation of the degree of polarization by certain methods have been formulated, and accuracies of these methods have been compared. In order to gain experience in photometric and polarization experiments, a single-beamed device was designed and tested. A description of this instrument is given along with a description of the double-beam polarimeter that is currently in use. The astronomical results that have been obtained at the telescope are listed. Observations were made on several stars, Uranus, and the Moon, including measurements of the degree of polarization at different wavelengths. Author

N63-14580 Aberdeen Proving Ground. Ballistic Research Labs., Md.
TWO WAVELENGTH, STREAK INTERFEROMETRY OF AN IONIZED, HEAVY GAS
F. D. Bennett, H. S. Burden, and D. D. Shear Jan. 1963 9 p 3 refs
(BRL-MEMO-1448)

The problem of measuring interferometrically both the mass density and the electron concentration in an ionized gas requires interferograms at two different wavelengths. Transient ionized gases can be examined by the method of streak interferometry. By inserting a dichroic mirror-divider and duplicate optical trains with appropriate filters, the basic streak interferometer can be modified to produce two simultaneous, streak interferograms at selected wavelengths. Author

N63-14599 California U., Livermore. Lawrence Radiation Lab.
MEASUREMENT OF HIGH-INTENSITY GAMMA RADIATION
C. R. Hatcher and C. P. Jupiter Jan. 31, 1963 17 p 3 refs
(Contract W-7405-eng-48)
(UCRL-7223) OTS: $0.50

The use of Victoreen ionization chambers to monitor high-intensity pulsed gamma radiation is discussed. It is shown that the type 154 thimble chamber gives valid readings in pulsed bremsstrahlung fields having peak intensities as high as 5×10^4 r/sec. The Victoreen chambers may then be used to calibrate a plastic fluor-photodiode detector whose saturation level is of the order of 10^{10} r/sec or greater. It is demonstrated that the sensitivity of the plastic fluor detector is constant for a total received dose of $\leq 2 \times 10^5$ r. Author

N63-14604 Michigan U. Electron Physics Lab., Ann Arbor
THE DESIGN AND CONSTRUCTION OF A HIGH-POWER UHF CRESTATRON
G. T. Konrad Griffiss AFB, N.Y., Techniques Lab., Aug. 1962 59 p 8 refs
(Contract AF 30(602)-2834)
(Tech. Rept. 52; RADC-TDR-62-446)

The design, construction, and experimental tests of a pulsed, high-power UHF Crestatron are described. The design procedures outlined in this report are useful for the construction of Crestatrons in general. The data presented show the operating characteristics of the Crestatron under small-signal as well as large-signal conditions. In addition, some experiments on the harmonic output of the Crestatron are described. Author

N63-14627 Naval Ordnance Lab., White Oak, Md.
FAST RISE-TIME PRESSURE-GAGE CALIBRATOR
R. H. Waser and V. C. D. Dawson Mar. 1963 14 p 3 refs
(NOLTR-62-218; Ballistics Research Rept. -86.)

This report describes a pressure-gage calibration device which simulates both the magnitude and the rise-time characteristics of pressure pulses experienced in shocktubes and shocktube wind tunnels. The advantage of a device of this type over a static calibration device is that it provides the ability to detect any difference in the static and dynamic characteristics of gages. Included is a discussion of the response of gages to pressures with short rise times. Author

N63-14644 Atomic Energy Commission. New Brunswick Lab., N.J.
A VERSATILE SIX-INCH RADIUS MASS SPECTROMETER FOR ISOTROPIC ANALYSIS OF SOLIDS, LIQUIDS, OR GASES
H. O. Finley, R. J. Hemmer, and L. C. Nelson, Jr. Apr. 1963 40 p 4 refs
(NBL-191) OTS: $0.75

A six-inch-radius mass spectrometer has been constructed for isotopic analysis requiring a minimum of instrumentation and personnel. Basically, the instrument is a six-inch-radius, 60°-sector-shaped analyzer. Its primary intended use is for low-mass work for boron and lithium analysis, as well as for comparison studies in the isotopic measurement of uranium. The work for high-mass gas samples is limited by the small radius, although the need for a dual collection ratio gas instrument is essential for comparison purposes. The instrument is designed for the analysis of a wide variety of elements by a number of different methods with minimum change in instrument geometry and source systems. The features that make possible the versatility of the instrument include the rigid all-welded construction of the analyzer tube, a solid-machined slit-valve and flange assembly, removal plates at both ends of the tube, and a pump-out between final slit of the ion source and the magnetic analyzer. Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-14248 National Aeronautics and Space Administration, Washington, D. C.
THE ACTION OF CERTAIN PHARMACOLOGICAL AGENTS ON INTRACRANIAL CIRCULATION (DEYSTVIYE NEKOTORYKH FARMAKOLOGICHESKIKH AGENTOV NA VNUTRICHEREPNOGO KROVOOBRASHCHENIYA)
A. A. Kedrov and A. I. Naumenko Apr. 1963 18 p 14 refs
Transl. by Faraday Translations from Fiziol. Zh. SSSR (Moscow), v. 40, no. 3, 1954 p 280-288
(NASA TT F-160) OTS: $0.50

The intracranial arteries are constantly in a state of tonic constriction of considerable intensity. The chemical agent with the most powerful action on the tonus of the intracranial arteries (tending to reduce it) is carbon dioxide. Nitrates, caffeine (with the longest-lasting effect), and dibazol are pharmacological substances with a direct depressant action on the tonus of the intracranial arteries. Nicotinic acid and citrin have no marked effect. Citral has a weakly expressed effect on the tonus of the intracranial arteries, tending to reduce it slightly. Author

N63-14260 Naval Radiological Defense Lab. Biological and Medical Sciences Div., San Francisco, Calif.
COMPARATIVE EFFECTS OF 50 KVP AND 250 KVP X RAYS ON THE DOG

S. J. Baum and E. L. Alpen Jan. 24, 1963 22 p 15 refs
(USNRDL-TR-616)

The subject of relative biological effectiveness of various ionizing radiations has been difficult and vexing to handle meaningfully when tissue distribution of dose is not uniform. It has been suggested by some that problems relating to linear energy transfer in tissues should appropriately be divided into two components—that relating to macroscopic energy distribution and that relating to energy distribution in terms of individual ionizing events. In this report, the former effect is evaluated principally by looking at the biological potency of a lower energy X-ray source (50 kVP) in the dog. Previously, it has been shown that no single dose parameter is adequate to express the biological potency of lower energy X-rays, although it was suggested that to the extent that it was possible to measure it, the dose to the critical organ, usually bone marrow, would be the most significant. Further studies have been completed on dogs exposed to high doses of X-radiation from a 50-kVp beryllium window generator. Doses of 4000 to 10,000 rad (air) at the potential midline of the subject have been shown to be as effective as doses of 200 to 300 rad of 250-kVp X-rays. Hematological comparisons of the two radiations show close correlation with mortality and a relative potency factor of 1/30 for the lower energy radiation. The lethal dose of 50-kVp X-rays for the dog is 7500 r (air). Serious lesions of the skin were seen as a complicating factor at all doses in excess of 4000 r (air). Dosimetry was done in tissue equivalent ("Mix D") wax phantoms using the rotational exposure method which is routine in this Laboratory. Phantom depth dose measurements with miniature ion chambers and chemical dosimetry in agar gels yielded essentially identical values of 3% for midline tissue dose. Author

N63-14316 National Aeronautics and Space Administration, Washington, D.C.

THE MECHANISM OF INTRACRANIAL CIRCULATION (O MEKHANIZME VNUTRICHEREPNOGO KROVOOBRASHCHENIYA)

A. A. Kedrov and A. I. Naumenko [USSR] Apr. 1963 27 p 35 refs
Transl. by Faraday Translations from Usp. Sovrem. Biol. (Moscow), v. 38, no. 2, 1954 p 183-198
(NASA TT F-159) OTS: $0.75

Short-term experiments on cats and dogs were carried out by making use of the method of electroplethysmography. Two small platinum electrodes were embedded in the cranial cavity of the animal, and a high-frequency alternating current was passed through the structures lying between the electrodes after hermetic conditions were restored. Author

N63-14333 Federal Aviation Agency. Civil Aeromedical Research Inst., Oklahoma City, Okla.

THE DEVELOPMENT OF REVERSIBLE HEMATURIA AND OLIGURIA FOLLOWING ELEVATION OF RENAL VENOUS PRESSURE

T. E. Emerson, L. B. Hinshaw, C. M. Brake, and P. F. Iampietro Jan. 1963 8 p 14 refs
(CARI Rept. 63-1)

An investigation was completed to study the acute effects of elevated renal venous pressure in the development of reversible gross hematuria and oliguria. Both isolated and intact dog kidney preparations were utilized. Results demonstrate that gross hematuria was produced as renal venous pressure was elevated, but not until a relatively high pressure was produced. The degree of hematuria increased as the pressure was further elevated, but disappeared rapidly following restoration to control pressure. The effect of renal venous pressure elevation on urine flow rate was one of progressive oliguria after a critical pressure was reached, and eventually anuria at the highest pressures. This effect was also reversible. Author

N63-14348 Martin Co., Baltimore, Md.

LUNAR LANDING STUDIES: HUMAN FACTORS

H. R. Greider Mar. 1962 16 p
(Tech. Memo. 24; ER-12300)

This technical memorandum reports the status of human factors effort on lunar landing module studies. The X-13 airplane program was reviewed because of the similarity with a lunar landing and launching. Human factors information obtained from simulator studies is presented. Some of the problems of obtaining and presenting the necessary display information are discussed, and a brief survey of the physiological requirements, a discussion of life support for the shuttle vehicle, and an outline of unresolved problems are presented. Author

N63-14364 National Aeronautics and Space Administration, Washington, D.C.

CEREBRAL PULSATION IN THE CLOSED CRANIAL CAVITY (O PUL'SATSII MOZGA V ZAKRYTOY POLOSTI CHEREPA)

Yu. Ye. Moskalenko (Acad. Sci., USSR) Apr. 1963 19 p 27 refs
Transl. by Faraday Translations from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 4, 1961 p 620-629
(NASA TT F-158) OTS: $0.50

Cerebral pulsation does exist in the closed cranial cavity. This pulsation is expressed as periodic fluctuations of the cerebrospinal fluid pressure of the order of 1 cm H_2O and back-and-forth movements of cerebrospinal fluid between the cavities of the cranium and the spine. Cerebral pulsation cannot be detected by the method of contrast roentgenoscopy or by the "transparent skull" method on account of their low sensitivity. Transmission of the pulse wave from the cerebral arteries to the veins is accomplished by means of cerebrospinal fluid pressure, bypassing the capillary route, so that capillary circulation remains smooth and uniform. Author

N63-14431 National Aeronautics and Space Administration, Washington, D.C.

SOME CHARACTERISTICS OF THE REGULATION OF INTRACRANIAL CIRCULATION (O NEKOTORYKH OSOBENNOSTYAKH REGULATSII VNUTRICHERPNOGO KROVOOBRASHCHENIYA)

A. A. Kedrov and A. I. Naumenko Apr. 1963 16 p 14 refs
Transl. by Faraday Translations from Fiziol. Zh. SSSR (Moscow), v. 37, no. 4, 1951 p 431-438
(NASA TT F-161) OTS: 0.50

A new technical approach was developed for studying the circulation in the cephalic tissues of animals and for investigating the basic regulatory mechanisms of intracranial circulation. To this end, observations on a total of 18 animals were made. By comparing the reactions of the extracranial and intracranial arteries of animals to different influences, the authors have attempted to determine the validity of clinical theories and methods aimed at deducing the conditions of intracranial circulation from a study of the behavior of extracranial vessels. Author

N63-14432 National Aeronautics and Space Administration, Washington, D. C.

PRESSURE FLUCTUATIONS IN THE HERMETIC CAVITY (O KOLEBANIYAKH DAVLENIYA V GERMETICHESKI ZAKRYTOY CHEREPA)

A. I. Naumenko Apr. 1963 16 p 11 refs Transl. by Faraday Translations from Fiziol. Zh. SSSR (Moscow), v. 42, no. 8, 1956 p 660-667
(NASA TT F-162) OTS: $0.50

In the closed cranial cavity, intracranial pressure is characterized by constant pulse and respiratory fluctuations. The pulse fluctuations are caused by rhythmical dilation of the intracranial arteries. When an animal is in repose, pulse fluctuations do not exceed 1 to 2 mm H_2O due to an increase in arterial pulsations associated with reduced tonus of the arterial wall influenced by increased carbon dioxide in the blood. The increase in the volume of the arteries during cardiac systole and the ensuing increase in intracranial pressure are easily compensated by periodic accelerations of the outflow of venous blood and corresponding decreases in the volume of the cerebral veins. Author

N63-14434 Yale U., New Haven Conn.
EXTRATERRESTRIAL MICROBIOLOGY
Wolf Vishniac Repr. from Aerospace Med., v. 31, Aug. 1960 p 678-680 Presented at the Aerospace Med. Assoc. Meeting, Miami, Fla., May 10, 1960
(NASA Grant NsG-19-59)

Mars shall be considered as a gigantic enrichment culture and a few predictions are offered concerning the microflora which exist there. These predictions deal only with those activities which such an organism would have to carry on to flourish in such an environment. Absence of oxygen from the Martian atmosphere means that photosynthesis cannot be of the oxygen-evolving type and it is assumed that it resembles photosynthesis as carried out by terrestrial photosynthetic bacteria. Concomitant with a light-dependent reduction of carbon dioxide, there must, therefore, be oxidation of some external substrate. As an example, reduced sulfur compounds such as hydrogen sulfide would be oxidized to sulfuric acid. The Martian counterpart of respiration which will balance photosynthesis therefore cannot be oxygen-dependent. It must be assumed that anaerobic types of respiration exist, such as sulfate reduction. Other anaerobic respirations which may take place on Mars, and which are known among terrestrial organisms, would be the use of carbon dioxide as a terminal respiratory substrate with the resultant formation of methane or nitrate which would give rise to free nitrogen. Photosynthetic organisms in light can frequently carry out oxidations of the type usually associated with strictly aerobic processes. It is therefore possible that in such an anaerobic environment one might find photosynthetic bacteria oxidizing ammonia. The reduction of nitrate and nitrogen fixation is also known to occur under anaerobic conditions. Similarly, methane might be oxidized by certain photosynthetic bacteria. The exploration of life on Mars may be carried out by a device which is in principle a culture tube, provided with a suitable medium which can be monitored for changes in acidity and turbidity.
I.v.L.

N63-14497 Rochester U., N.Y.
POSSIBLE EFFECTS OF WEIGHTLESSNESS ON CALCIUM METABOLISM IN MAN
William F. Neuman Jan. 18, 1963 17 p 15 refs
(Contract W-7405-eng-49)
(UR-622) OTS: $0.50

In the Man in Space Program, manned flights of two weeks' duration are projected for the immediate future. Such periods of immobilization under gravity-free conditions are likely to produce mobilization of skeletal calcium, hypercalcemia, and hypercalcuria. Data on fracture patients, polio patients, and immobilized normal "volunteers" are reviewed to provide a basis for a tentative evaluation of the immediate problem, and to delineate those data needed for an evaluation of the problem in more protracted flights scheduled for the future.
Author

N63-14570 Naval Radiological Defense Lab., San Francisco, Calif.
MOTOR RESPONSES IN MOTHS TO LOW INTENSITY X-RAY EXPOSURE
J. C. Smith, D. J. Kimeldorf, and E. L. Hunt Feb. 25, 1963 12 p 9 refs
(USNRDL-TR-622)

A brief burst of X-rays elicited flight activity in the moth when placed in a darkened X-ray exposure room. Wing-beat activity was recorded as an index of this behavior. Wing-beat activity could be initiated in resting moths or amplitude augmented in active moths by X-ray dose rates of 0.01 to 1.5r/sec., with a latency of less than one second after onset of exposure.
Author

N63-14633 California U., Berkeley. Lawrence Radiation Lab.
SOME PROPERTIES OF A SUBUNIT OF THE HIGHER PLANT CHLOROPLAST LAMELLA
John Biggins and Roderic B. Park *In its* Bio-Organic Chemistry Quarterly Report, Sept. through Nov. 1962 Jan. 18, 1963 p 13-22 7 refs (See N63-14631 10-07) OTS: $2.50

A subunit from the spinach chloroplast lamellae was isolated. Its absorption spectra is found to be similar to that of whole chloroplasts, and it is active in the Hill reaction. Its sedimentation coefficient is given with its molecular weight, and it is found to satisfy some criteria for the photosynthetic unit and the quantasome.
D.E.P.

N63-14635 California U., Berkeley. Lawrence Radiation Lab.
PHOTO-INDUCED ABSORPTION CHANGES. I—INSTRUMENTATION
Irwin D. Kuntz, Jr. *In its* Bio-Organic Chemistry Quarterly Report, Sept. through Nov. 1962 Jan. 18, 1963 p 56-68 12 refs (See N63-14631 10-07) OTS: $2.50

A preliminary discussion of a high-sensitivity rapid-response spectrophotometer is given. Sampling techniques are used to allow the presentation of microsecond transients. These techniques allow the use of long-time constant filters to improve instrument sensitivity without distortion of the transient waveform. An obvious limitation of this approach is the requirement for a repetitive signal. The noise reduction properties of this type of circuitry are discussed.
D.E.P.

N63-14665 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
OPERATING CHARACTERISTICS OF THE LAUTERBACH AND DAUTREBANDE AEROSOL GENERATORS Technical Progress Report
T. T. Mercer, M. I. Tillery, and M. A. Flores Feb. 1963 34 p 8 refs
(Contract AT(29-2)-1013)
(LF-6) OTS: $0.75

The operating characteristics of the Lauterbach and Dautrebande aerosol generators have been studied. The output, in terms of microliters of solution aerosolized per liter of air passing through the jet, was not appreciably affected by either the diameter of the jet orifice or the concentration of the solution. The output increased with increasing pressure drop, ΔP, across the jet orifice, approaching an asymptote apparently negligibly greater than the output at $\Delta P = 50$ psi. The median diameters of the particle-size distributions were unaffected by either orifice diameter or jet pressure. They varied with solution concentration but to a lesser extent than had been expected. Mass median diameters, however, showed an effect of jet pressure as well as solution concentration. The airflow through the jet, the effect of a prehumidifier on the water vapor content of the jet air, the cooling effect of the jet air on the generator solution, and the amount of water vapor carried away by the jet air were also determined and the results are discussed.
Author

N63-14712 Naval Radiological Defense Lab., San Francisco, Calif.
DIFFERENTIAL EFFECTS OF SPECIFIC ANTISERA ON THE REJECTION OF ALLOGENIC AND XENOGENIC SKIN GRAFTS BY SUBLETHALLY X-IRRADIATED MICE
M. L. Tyan and L. J. Cole Mar. 4, 1963 18 p 14 refs
(USNRDL-TR-625)

Twelve- to fourteen-week-old female LAF_1 mice, nonsensitized or presensitized with two consecutive BALB/c or rat skin grafts, received 670 rad whole body X-radiation and orthotopic tail grafts of LAF_1, BALB/c, C3D/2 and rat skin. Certain groups of mice received specific antisera intraperitoneally, produced in response to BALB/c or rat spleen cells or to two consecutive BALB/c or rat skin grafts. The data indicate that the first-set response to an allogenic skin graft can be significantly inhibited, in sublethally irradiated mice, by specific antisera, while the first-set response to a xenogenic skin graft remains resistant to similar treatment. Specific antisera had no effect upon a pre-existing second-set response. The significance of these data is discussed.
Author

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-14295 University of Southern Calif. Engineering Center, Los Angeles

OPERATIONAL CHARACTERISTICS OF A CRYOPUMP USED IN A LOW DENSITY WIND TUNNEL Technical Note

J. G. Everton Oct. 1962 23 p 4 refs

(USCEC-93-201)

The first large-scale cryopump in this country was placed in operation at USCEC in 1959. This paper discusses: (1) the design and operation of the original cryopump, (2) the modification of the pump, and (3) operational characteristics subsequent to the modification. Author

N63-14619 North American Aviation, Inc. Space and Information Systems Div., Downey, Calif.

TITANIUM TANKAGE PROGRAM. PHASE II—TITANIUM TANKAGE DEVELOPMENT Third Quarter Report, 15 Dec. 1962 to 15 Mar. 1963

W. H. Morita Edwards AFB, Calif., Rocket Res. Lab., Apr. 1963 124 p

(Contract AF 04(611)-8505)

(RTD-TDR-63-1023; SID 63-318)

The Phase II Titanium Tankage Development consists of the fabrication and testing of two subscale tanks employing titanium honeycomb sandwich construction, to verify manufacturing processes and mass fraction increases. Fabrication techniques are employed which potentially are applicable to large booster tankage-production methods. The bonding of aluminum honeycomb to titanium, the forming of the bulkhead, welding of thin-gage titanium, and the bulkhead cylinder close-out joint represent primary development areas. Author

N63-14652 Rock Island Arsenal Lab., Ill.

IMPROVING THE RUST PREVENTIVE PROPERTIES OF MULTI-PURPOSE GREASES Technical Report

R. L. Young Jan. 31, 1963 20 p 11 refs

(RIA-63-313) OTS: $0.50

Eighteen compounds or mixtures were selected for testing as rust-preventive additives for greases. They were mixed into a selected base grease in predetermined percentages. A screening test was developed and those additives showing up well on it were further tested. The greases containing the best performing additives were checked to determine if any of the requirements of MIL-G-10924B, Grease, Automotive and Artillery, had been seriously altered. The minimum effective percentages of the additive displaying the best protection were determined. The most effective additives were incorporated, in minimum concentration, in commercial greases which had failed to meet the rust preventive test to see if improvements could be made. Author

N63-14653 Rock Island Arsenal Lab., Ill.

EFFECT OF STORAGE ON LUBRICATING GREASE COMPATIBILITY Technical Report

F. S. Meade and R. L. Young Jan. 9, 1963 53 p 17 refs

(RIA-63-88) OTS: $1.50

The compatibility of binary mixtures of twelve types of lubricating greases, when mixed in the three component ratios, 10% to 90%, 50% to 50%, and 90% to 10%, and after storage for eighteen months was determined. Approximately 15% of the grease mixtures were reexamined for compatibility after three-years' storage. The greases studied included soap thickened, nonsoap thickened, and an organic thickened product. Both mineral oil and synthetic fluid types were represented. Approximately 64% of the binary grease mixtures were compatible after an eighteen-month-storage period. As the storage period was increased to three years, the number of compatible mixtures was decreased. More grease mixtures were incompatible after eighteen months' and after three-years- storage than were incompatible immediately after preparation. In only a very few instances did grease mixtures, which were incompatible immediately after preparation, become compatible after storage. Author

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-14236 Aerospace Corp. Materials Sciences Lab., El Segundo, Calif.

A PORTFOLIO OF EXPERIENCE IN REFRACTORY METAL PROTECTIVE SYSTEMS RESEARCH

D. H. Leeds Mar. 11, 1963 391 p 3792 refs

(Contract AF 04(695)-169)

(TDR-169(3240-31)TR-2; supersedes TDR-169(3240-31)TR-1; SSD-TDR-63-51)

The purpose of this document is twofold: to direct research in the field of refractory metal protective coatings away from present silicide approaches and into systems capable of protection over 3500° F, and to familiarize the materials engineer with past and current research in his field (including the valuable examples set by silicide protection theory), thereby enabling him to interpret his own science for the designer. The report is divided into five major sections: molybdenum; columbium; tungsten; tantalum; and a new section, general, which contains references to oxidation testing of refractory-metal systems and to areas of research allied to the one vital problem, the protection of these metals from unfavorable environments at elevated temperatures. Author

N63-14245 Radio Corp. of America. RCA Labs., Princeton, N.J.

SUPERCONDUCTIVITY IN METALS AND ALLOYS Technical Documentary Report [Nov. 8, 1961 - Nov. 7, 1962]

W. H. Cherry et al Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1963 68 p 65 refs

(Contract AF 33(657)-7733)

(ASD-TDR-62-1111)

Research efforts covered the following: (1) Measurements were made of the Kapitza resistance in tin and indium and its change at the superconducting transition. For comparison with theory, measurements were also made on the insulator, sapphire. An attempt to detect an electric field dependence of the Kapitza resistance in platinum had negative results. (2) A new method for the preparation of β-tungsten compound superconductors, such as Nb_3Sn, was developed. Both the properties of the deposited material and the extension of this method to such possible β-tungsten compounds as niobium germanide, niobium silicide, vanadium-gallium, vanadium

silicide, and niobium-gallium are described. (3) The transition temperature of niobium stannide is shown to depend not only on the stoichiometry, but also on the state of order of the lattice. Resistivity of Nb_3Sn is given as a function of temperature from 4.2° K to 370° K. Tunneling measurements on deposited Nb_3Sn indicate the existence of a bandgap ($2_\Delta 0$). Preliminary results are compatible with the relation: $2_\Delta 0 \approx 1.8\ T_c$. (4) Penetration depth measurements were made on deposited Nb_3Sn. The temperature dependence is similar to that obtained for other superconductors, but the value of the penetration depth at T = 0° K (2,880 Å) is almost an order of magnitude larger than that observed for soft superconductors. This value and the predictions of the BCS (Bardeen, Cooper, and Schrieffer, 1957) theory in the local limit are compared. A comparison is also made with recent theories of hard superconductors. (5) Quenching currents were measured on deposited Nb_3Sn. Preliminary results indicate a zero field quenching current close to that predicted by the Silsbee hypothesis assuming a thermodynamic critical field $H_0 \approx 5{,}000$ gauss. For transverse fields the quenching current drops rapidly, whereas for longitudinal fields the quenching current rises. Comparison of these results is made with recent theories of hard superconductors. (6) Thermal conductivity measurements were made on Nb_3Sn. Preliminary results indicate qualitative agreement with the predictions of the microscopic theory of superconductivity.

Author

N63-14266 Naval Research Lab., Washington, D. C.

RELATIVE THERMAL CONDUCTIVITY AND EXPANSION CHARACTERISTICS OF SEVEN TRANSDUCER MATERIALS

K. G. Skinner *In its* Report of NRL Progress Oct. 1962 p 8-12 1 ref (See N63-14264 10-23) OTS: $1.25

Investigations at the U.S. Naval Research Laboratory have shown that the barium titanates and the lead-zirconium titanates exhibit minor differences in thermal conductivity but significant differences in thermal expansion characteristics. There was a maximum spread of about 10 percent between the lowest and highest value of thermal conductivity for the two types of titanates. The thermal expansion of the lead-zirconium titanates was about 50 percent greater than that of the barium titanates. Hence, it appears that neither material should be substituted for the other without modification of component parts.

Author

N63-14283 Defense Metals Information Center. Battelle Memorial Inst., Columbus, Ohio

REVIEW OF USES FOR DEPLETED URANIUM AND NONENERGY USES FOR NATURAL URANIUM

M. S. Farkas Feb. 1, 1963 28 p 20 refs
(Contract AF 33(616)-7747)
(DMIC-Memo-165)

Uses for depleted uranium and nonenergy uses for natural uranium found in the United States and Canada are presented with a view to alleviating current stockpile accumulations. Generally, only uses or potential uses which could account for an annual consumption of 1 ton or more of uranium are given. The following specific areas are discussed: past nonenergy consumption of uranium; properties of uranium and uranium alloys; typical room-temperature properties of uranium; nuclear uses for depleted uranium; uses of uranium in shielding, ammunition, and weapons; and counterweight materials of uranium.

A.R.B.

N63-14294 Bureau of Mines. Albany Metallurgy Research Center, Ore.

QUARTERLY METALLURGICAL PROGRESS REPORT NUMBER 17 FOR THE PERIOD OF OCTOBER 1 THROUGH DECEMBER 31, 1962

A. H. Roberson et al [1962] 24 p
(Contract AT(11-1)-599)
(USBM-U-1001) OTS: $0.50

Metallurgical research is reported as follows: rare-earth alloys, hafnium alloys, thorium alloys, refractory high-temperature alloys, solid-state diffusion bonding, and melting.

R.C.M.

N63-14299 Armour Research Foundation, Chicago, Ill.

EMBRITTLEMENT OF METALS BY ORGANIC LIQUIDS Quarterly Report, Dec. 1, 1962-Feb. 28, 1963

W. Rostoker Mar. 5, 1963 19 p 5 refs
(Contract DA-11-022-ORD-3108)
(ARF-B183-13)

The existing published knowledge on the subject of embrittlement of metals by organic liquids is reviewed, and a modus operandi is outlined for an extensive study of the incidence of such embrittlement. Evaluation schemes are based primarily on static and dynamic fatigue tests. A first appraisal of 48 selected organic fluids in static fatigue has shown no propensities for embrittlement.

Author

N63-14402 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

CONTINUED INVESTIGATION OF AN ADVANCED-TEMPERATURE, TANTALUM-MODIFIED, NICKEL-BASE ALLOY

John C. Freche and William J. Waters Washington, NASA, Apr. 1963 31 p 17 refs
(NASA TN D-1531) OTS: $0.75

The investigation of an advanced-temperature, NASA nickel-base alloy having a nominal composition in weight percent of 8 tantalum, 6 aluminum, 6 chromium, 4 molybdenum, 4 tungsten, 2.5 vanadium, 1 zirconium, 0.125 carbon, and balance nickel was continued. This alloy appears to have considerable potential for various aerospace applications. The average ultimate tensile strength of the as-forged alloy ranged from 158,000 psi at room temperature to 18,000 psi at 2100° F. This compares with 135,000 and 34,000 psi, respectively, for the as-cast alloy. Stress-rupture data obtained up to 2100° F at 15,000 psi indicate average rupture lives for the as-cast alloy of 1000, 100, and 10 hours at 1817°, 1915°, and 2015° F, respectively. Impact tests provided evidence of alloy ductility. Additional evidence of workability was also obtained. Room-temperature forging, accomplished by unidirectional forging techniques, readily flattened ½-inch-diameter, as-cast bars, and thickness reductions of 50 percent were consistently obtained. In oxidation tests at 1900° F, relatively low oxidation rates were obtained, although spalling of the oxide scale was observed upon cooling through the 800° to 600° F range. The weight gain per unit surface area for the NASA alloy was 2.9 and 6.5 milligrams per square centimeter after 50 and 200 hours exposure, respectively. These are not excessive oxidation rates, particularly for short-time applications; however, spalling may pose a problem in applications where frequent temperature cycling occurs.

Author

N63-14405 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

INFLUENCE OF FLUORINE ENVIRONMENT ON THE MECHANICAL PROPERTIES OF SEVERAL SHEET ALLOYS

Hadley T. Richards and Morgan P. Hanson Washington, NASA, Apr. 1963 15 p 8 refs
(NASA TN D-1706) OTS: $0.50

The effect of a liquid-fluorine environment on the mechanical properties of several sheet alloys was investigated. The smooth and notch tensile strengths and the elongation properties of steel, nickel, aluminum, and titanium alloys were determined in liquid-nitrogen and liquid-fluorine environments (–320° F). Possible deterioration in the presence of fluorine and high stresses was detected by comparing the properties of alloys exposed to the two fluids at –320° F. The commercial-quality fluorine used contained contaminants. The results of tests in liquid fluorine indicated possible degradation of the mechanical properties of the sheet alloys. Following 2-hour

exposure, the decrease in tensile strength ranged from negligible to a maximum reduction of approximately 11 percent. Elongation showed similar trends. The sharp-notch strengths appeared to be unaffected by the liquid fluorine. Variations in test results and surface appearance could have been due to varying amounts of contaminants in the liquid fluorine. There was no evidence of ignition on any of the specimens that were fractured in the liquid-fluorine environment. Author

N63-14486 Climax Molybdenum Co. of Michigan, Detroit
ARC-CAST MOLYBDENUM- AND TUNGSTEN-BASE ALLOYS (1960-1961)
M. Semchyshen, R. Q. Barr, and E. Kalns Nov. 1962 145 p 9 refs
(Contract Nonr-2390(00))

The progress of work aimed at explaining the strengthening mechanisms operative in several molybdenum-base alloys is described. The optimum carbon contents for conventionally processed molybdenum-base alloys containing titanium, hafnium, zirconium, and titanium + zirconium are defined. The possibilities of increasing the strengths and reducing the optimum carbon content of these materials through solution and aging heat treatments are discussed. Attempts to prepare wrought sections of molybdenum-base alloys containing nominally 10% Cb and/or 10% Ta were only marginally successful owing to difficulties encountered in working the vacuum-arc-cast ingots. A series of experiments is described wherein various melting and deoxidation practices are evaluated in connection with the 50% Mo-50% W alloy. Alloys based on tungsten or on various molybdenum-tungsten ratios have received considerable attention. Considerable difficulty was encountered in converting certain of the alloys of this type to bar stock. Outstanding elevated-temperature tensile and stress-rupture properties are reported for a number of the compositions that were successfully converted to wrought stock. Author

N63-14590 Central Inst. for Industrial Research, Blindern (Norway)
RESEARCH ON THE BEHAVIOUR OF TANTALUM AND TANTALUM BASE ALLOYS AT HIGH TEMPERATURES (Final) Technical Report [Apr. 1, 1961-Mar. 31, 1962]
Per Kofstad Apr. 1, 1962 14 p 9 refs Previously processed as Technical Notes No. 1, 2, 3, and 4; for abstracts see N62-10568 03-18; N62-10569 03-18; N62-10609 03-18, and N62-13138 09-08, respectively
(Grant AF-EOAR-61-42)
(ARL-62-397)

The report summarizes studies of the oxidation behavior of tantalum at 300° to 550° C, X-ray diffraction and metallographic investigations of metallic oxide phases (suboxides) of tantalum and niobium, which are reaction products in the oxidation of these metals, and studies of oxidation of Ta-10% W at 700° to 1300° C. Author

N63-14597 California U., Livermore. Lawrence Radiation Lab.
CURRENT BERYLLIUM LITERATURE: A SELECTED BIBLIOGRAPHY JANUARY 1961—DECEMBER 1962
Jan. 1963 343 p 2081 refs
(Contract W-7405-eng-48)
(UCRL-5705(Suppl. 2)) OTS: $4.50

In each section of this bibliography, books and journal articles appear first, arranged alphabetically by author. Anonymous articles are arranged alphabetically by journal name at the end of each grouping. These are followed by reports and patents arranged by report numbers. Translations are located in the groupings in accordance with their original form i.e., book, journal, etc. Because of diversity of subject content, some references are located in more than one section. Many of the reports listed here are research and development reports released by the Atomic Energy Commission, Army, Navy, Air Force, and agencies of the Federal Government and their contractors. Most of these reports are available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. Author

N63-14649 Columbia U., New York, N. Y.
INFLUENCE OF RESIDUAL STRESSES ON RANDOM FATIGUE LIFE, IN BENDING, OF NOTCHED 7075 ALUMINUM SPECIMENS [Summary Report, Aug. 1, 1960-Aug. 31, 1962]
R. A. Heller, M. Seki, and A. M. Freudenthal Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Dec. 1962 57 p 20 refs
(Contract AF 33(616)-7042)
(ASD-TDR-62-1075)

Theoretical and experimental results of investigations conducted to determine the effects of residual stresses on fatigue-damage accumulation and fatigue life, under both constant amplitude and randomized exponential stress distributions, of 7075-T6 circumferentially notched, rotating bending specimens are presented. The variation of the strength reduction factor as a function of prestress and load spectrum is examined. An approximate analysis of the elastic-plastic stress distribution at the minimum cross section is suggested for predicting fatigue behavior. The results indicate that the linear (Miner) cumulative-damage rule quite generally overestimates fatigue lives except in the alternating plasticity range, and that the endurance limit is considerably reduced as a result of stress interaction, provided that in the application of the linear-damage rule the S-N-diagram for the prestressed specimen is used. In the range of alternating plasticity at the root of the notch $10^3 < N < 10^4$, the linear rule consistently underestimates the fatigue life. Author

N63-14670 Massachusetts Inst. of Tech. Metals Processing Lab., Cambridge
THE INVESTIGATION OF THE ACTIVATED SINTERING OF TUNGSTEN POWDER Final Report, Nov. 1, 1961-Jan. 31, 1963
J. H. Brophy, H. W. Hayden, A. L. Prill, and J. Wulff Feb. 28, 1963 117 p 75 refs
(Contract NOw-61-0326-d)

CONTENTS:
1. THE ACTIVATED SINTERING OF TUNGSTEN WITH GROUP VIII ELEMENTS p 3-39 41 refs (See N63-14671 10-18)
2. GRAIN BOUNDARY DIFFUSION IN TUNGSTEN SINTERING, PART II p 40-51 10 refs (See N63-14672 10-18)
3. THE ROLE OF PHASE RELATIONSHIPS IN THE ACTIVATED SINTERING OF TUNGSTEN, PART III p 52-64 8 refs (See N63-14673 10-18)
4. THE RELATIONSHIP BETWEEN LIQUID PHASE SINTERING AND ACTIVATED SINTERING OF TUNGSTEN, PART IV p 65-108 16 refs (See N63-14674 10-18)

N63-14671 Massachusetts Inst. of Tech. Metals Processing Lab., Cambridge
THE ACTIVATED SINTERING OF TUNGSTEN WITH GROUP VIII ELEMENTS, PART I
In its Investigation of the Activated Sintering of Tungsten Powder Final Report, Nov. 1, 1961-Jan. 31, 1963 Feb. 28, 1963 p 3-39 41 refs (See N63-14670 10-18)

The densification rate in sintering tungsten powder is shown to be significantly increased by small additions of group VIII transition elements. Palladium appears to have the greatest effect, followed in order by nickel, rhodium, platinum, and ruthenium. A mechanism for this increased densification rate has been proposed, based on the overall shrinkage of the powder compact, which is caused by interaction at the interface of the powder and the carrier phase layer of the activant. This suggests that all sintering is one application of the mass transport processes, since liquid-phase sintering is seen to be just a special case of carrier-phase sintering. D.E.R.

N63-14672 Massachusetts Inst. of Tech. Metals Processing Lab., Cambridge
GRAIN BOUNDARY DIFFUSION IN TUNGSTEN SINTERING, PART II

In its Investigation of the Activated Sintering of Tungsten Powder Final Report, Nov. 1, 1961-Jan. 31, 1963 Feb. 28, 1963 p 40-51 10 refs (See N63-14670 10-18)

Small amounts of densification observed in the presintering of tungsten are shown to result from the grain boundary diffusion of tungsten atoms. This accounts for the strengthening observed after presintering at 1000° to 1200° C. Additions of iridium to tungsten powder decelerate the interfacial diffusion of tungsten atoms; this fact strengthens the interpretations of previous experiments showing that the sintering of tungsten is activated with small additions of certain Group VIII transition metals. Iridium causes a deceleration, while the others cause an acceleration of the characteristic interfacial transport of tungsten atoms. D.E.R.

N63-14673 Massachusetts Inst. of Tech. Metals Processing Lab., Cambridge

THE ROLE OF PHASE RELATIONSHIPS IN THE ACTIVATED SINTERING OF TUNGSTEN, PART III

In its Investigation of the Activated Sintering of Tungsten Powder Final Report, Nov. 1, 1961 - Jan. 31, 1963 Feb. 28, 1963 p 52-64 8 refs (See N63-14670 10-18)

Additions to tungsten powders of those Group VIII transition metals that form intermetallic compounds produce a different sintering behavior than is observed in the cases of those additions that form extensive composition with solid solutions or intermediate phases. These phase relationships are proved by comparing the case of iron or cobalt with the case of the other transition metals, in which shrinkage is independent of the Group VIII metal concentration above that necessary to form continuous layers. But with iron or cobalt, linear shrinkage decreases past the point at which a continuous layer is formed on the surfaces of the tungsten powders. This effect is explained by the continuous trend from the formation of epitaxial layers with iron and cobalt to the forming of the intermetallic compounds. D.E.R.

N63-14674 Massachusetts Inst. of Tech. Metals Processing Lab., Cambridge

THE RELATIONSHIP BETWEEN LIQUID PHASE SINTERING AND ACTIVATED SINTERING OF TUNGSTEN, PART IV

In its Investigation of the Activated Sintering of Tungsten Powder Final Report, Nov. 1, 1961-Jan. 31, 1963 Feb. 28, 1963 p 65-108 16 refs (See N63-14670 10-18)

Activated sintering and liquid-phase sintering are examined as two special cases of carrier-phase sintering. The influence of copper dissolved in nickel during the activated sintering of tungsten is determined by sintering tungsten-copper-nickel alloys in the presence of either a solid or a liquid phase. It is shown that the alloys sinter by a solution-precipitation process, that linear shrinkage for the alloys increases with increasing tungsten solubility, that this shrinkage is independent of the weight fraction matrix above a minimum, that the corrected linear shrinkage versus time plot can be obtained by eliminating the effect of initial rearrangement shrinkage, and that the same mechanisms of sintering prevail in both liquid- and solid-phase sintering of tungsten-nickel-copper alloys. D.E.R.

19 MATERIALS, NONMETALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-14298 Westinghouse Electric Corp. Westinghouse Research Lab., Pittsburgh, Pa.

RESINS AND REINFORCED LAMINATES CAPABLE OF MAINTAINING USEFUL STRUCTURAL PROPERTIES AT 600-650° F: AROMATIC AMIDES AND PYROMELLITIMIDES [First Interim Report, June 1-Sept. 30, 1962]

James H. Freeman, Lawrence W. Frost, George M. Bower, and Edward J. Traynor Sept. 30, 1962 30 p 9 refs
(Contract AF 33(657)-9078)
(Res. Rept. 62937-33501)

High molecular weight polymers were prepared by reaction of pyromellitic dianhydride with various aromatic diamino compounds. An order of relative thermal stability was established for various organic structural groups linking aryl rings. The basis was weight loss of thin films of polymer material at 617° F (325° C) in air. Electrical properties were used to determine the second-order transition point, Tg, for those several polymers possessing the highest thermal stability. Knowledge of Tg was used to indicate a minimum possible laminating temperature. Glass reinforced laminates were prepared by a dry-bonding technique involving little flow. Data showing retention of flexural strength at temperature after various periods of aging at 572°, 600°, and 650° F are presented. Author

N63-14341 Avco Corp., New York, N.Y.

INVESTIGATION OF BEHAVIOR OF NEW PLASTIC AND COMPOSITE MATERIALS Quarterly Progress Report No. 2, Oct. 1-Jan. 15, 1963

R. R. John Wright-Patterson AFB, Ohio, Aeronautical Systems Div., Feb. 1, 1963 3 p
(Contract AF 33(657)-8892)

Seventeen samples were obtained and tested. The samples were reinforced plastics consisting of either carbon or refrasil reinforcing agents and a series of different chemical resins as binders. The specimens were tested in a subsonic jet at a nominal pressure of 1 atmosphere, a heat flux of 1050 BTU/ft^2/sec, and an air enthalpy of 8150 BTU/lb. Measurements were made of the time-history of the sample surface recession, sample brightness surface temperature, and surface radiation. Author

N63-14496 Forest Products Lab., Madison, Wis.

INTERLAMINAR PROPERTIES OF FIVE PLASTIC LAMINATES

Kenneth E. Kimball Dec. 1962 21 p 4 refs
(Contract AF 33(616)61-06; and BuWeps Order 19-61-8041-WEPS)
(FPL 1890)

Laminates of phenolic and silicone resins reinforced with 181 glass fabric, and laminates of an epoxy resin reinforced with 181 glass fabric or with glass filaments in either a unidirectional or a crossply pattern, were evaluated for their interlaminar properties. Results of evaluation in tension, compression, and shear in the interlaminar plane are shown for each of the five laminates. Author

N63-14518 High Temperature Materials, Inc., Boston, Mass.

RESEARCH ON NEW AND IMPROVED THERMALLY PROTECTIVE FIBER REINFORCED COMPOSITE MATERIALS [Progress Report]

R. G. Bourdeau and F. E. Papalegis Feb. 1963 26 p
(Contract AF 33(657)-8651)

Pyrolytic graphite whiskers with diameters as small as 4 to 5 microns and with lengths greater than two inches have been grown. These whiskers were also obtained in high concentrations with little bridging from one to another. Whisker tensile strengths were measured and an appreciable increase in strength was observed with improved surface characteristics; strengths from approximately 60,000 psi to 340,000 psi were obtained. Commercially available graphite filaments surfaced with pyrolytic graphite were heat treated to temperatures over 3000° C, and a marked increase in filament flexibility was obtained. These filaments can be bent repeatedly to small

radii without failure. Oxidation tests of treated and untreated carbon filaments showed the greater oxidation resistance of pyrolytic graphite surfaced filaments over the base filaments. As-received graphite filaments were also improved by a pyrolytic graphite surfacing
Author

N63-14578 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Flugzeugbau, Brunswick (W. Germany)

UNTERSUCHUNGEN ÜBER DIE ZERSTÖRUNGSFREIE PRÜFUNG VON VERBUNDWERKSTOFFEN AUS GLASFASER UND KUNSTHARZ MIT ULTRASCHALL [INVESTIGATION ON NONDESTRUCTIVE TESTING OF GLASS FIBER AND SYNTHETIC RESIN COMPOSITES BY ULTRASONICS]

G. Niederstadt June 1, 1962 48 p 10 refs In German
(DFL-192)

A testing installation, which permits the determination of sound travel time in test specimens, is described. If the sound path and the thickness of the materials are known, the dynamics of the modulus of elasticity of the test specimen can be calculated. Since glass fiber synthetics are orthotropic and the elasticity characteristics are therefore direction-controlled, the determination of sound travel time offers a simple means of controlling grain direction. A polar diagram is presented which shows that a small change in grain direction results in marked changes in mechanical properties. This can, under certain conditions, exert a stronger effect than the usual failure possibilities such as bubbles and cracks. This method can be adapted to manufacturing control of pressed construction composites with glass fiber matting reinforcement where the material must be tested to see if local fiber elutriation has occurred. Since this elutriation results in resin-rich places, which have a lower modulus of elasticity than the rest of the construction composites, such failures can be detected easily with ultrasonics. Small air cavities in the order of magnitude of less than a millimeter cannot be detected by this method, since the analytical power of the sound waves is insufficient. However, if these failures affect the modulus of elasticity of the specimen, ultrasonic testing can be employed. I.v.L.

N63-14710 General Electric Co. Knolls Atomic Power Lab., Schenectady, N.Y.

PHASE EQUILIBRIA IN THE BORON CARBIDE—SILICON CARBIDE SYSTEM

D. R. Secrist and F. H. Guzzetta Oct. 5, 1962 23 p 5 refs
(Contract W-31-109-eng-52)
(KAPL-2216) OTS: $0.50

The boron carbide-silicon carbide system is quasi-binary and contains a eutectic of composition 70 ±2 wt % B_4C and 30 ±2 wt % SiC at a temperature of 2300° ±20° C. The solid solubility of both B_4C in SiC and SiC in B_4C is <2 wt % at this temperature, based on metallographic and X-ray analyses. The SiC corresponds to the hexagonal (α) allotrope when the compositions contain >50 wt % SiC. The cubic (β) form of SiC is stabilized in compositions which contain <50 wt % of SiC.
Author

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-14239 Naval Air Development Center. Aviation Medical Acceleration Lab., Johnsville, Pa.

A SYSTEM FOR PROGRAMING EXPERIMENTS AND FOR RECORDING AND ANALYZING DATA AUTOMATICALLY

Robert M. Herrick and John S. Denelsbeck Feb. 20, 1963 21 p 1 ref
(NADC-MA-6302)

An inexpensive system designed for use in complex operant conditioning experiments is described. Some of its key features are: removable plugboards, time-sharing of components, and recordings suitable for automatic analysis. Included are flow diagrams of the system and sample logic diagrams for programing experiments and for analyzing data.
Author

N63-14241 Massachusetts Inst. of Tech., Cambridge

MAGNETIC TAPE COPIES OF MIT GEOPHYSICS PROGRAM SET I (TIME SERIES PROGRAMS FOR THE IBM 709, 7090) Scientific Report No. 4

S. M. Simpson, Jr. Dec. 30, 1962 53 p
(Contract AF 19(604)-7378; ARPA Order 180-61, Amend. 2; Proj. Vela-Uniform)
(AFCRL-63-282)

A set of over a hundred programs written for the IBM 709 and 7090, related to time series computations, has been assembled as "MIT Geophysics Program Set I" and is now available. In the immediate future, distribution will be handled by producing magnetic tape copies of the symbolic decks for qualified applicants who supply their own blank tapes. As soon as is feasible the distribution will be handled by VESIAC. The topics involved in the program set include convolution, auto- and cross-correlation, auto- and cross-spectral analysis, sine and cosine transforms, simultaneous equations, least squares prediction and filtering, factorization of spectra, operations with polynomials, probability distributions, statistical hypothesis testing, random digits, interpolation, seismometer impulse response, miscellaneous vector operations, compact tape storage and retrieval, oscilloscope plotting, and miscellaneous utility routines. The programs are practically all subroutines or functions compatible with FORTRAN-II calling sequences.
Author

N63-14249 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A RECURSION RELATION ASSOCIATED WITH A CERTAIN SPECIAL TYPE DETERMINANT

E. Baylis Shanks Washington, NASA, Apr. 1963 6 p
(NASA TN D-1112) OTS: $0.50

This paper is concerned with the development of formulas of a recursive nature from a certain special-type determinant. These formulas lead directly to computational routines that are effective in the evaluation of such determinants. Such computational routines are also applicable to a wide variety of recursion formulas, obtained by specialization of the parameters involved.
Author

N63-14261 Midwest Research Inst., Kansas City, Mo.

JACOBI POLYNOMIAL EXPANSIONS OF A GENERALIZED HYPERGEOMETRIC FUNCTION OVER A SEMI-INFINITE RAY Technical Report

Yudell L. Luke and Jet Wimp Mar. 15, 1963 24 p 15 refs
(Contract Nonr-2638(00)(X))

It is known that a function satisfying certain conditions has an expansion in Jacobi polynomials converges uniformly over a finite interval. In this report we determine a wide class of higher transcendental functions which have a convergent Jacobi polynomial expansion over a semi-infinite interval. We show how, in special cases, the coefficients may be calculated and our examples include the Bessel functions $K_\nu(x)$ and $K_f(x)$, the error function, and the sine, cosine, and exponential integrals. The process described may be interpreted as a summation technique which converts an ordinarily divergent asymptotic series into convergent series.
Author

N63-14263 Army Missile Command, Redstone Arsenal, Ala.
TABLES FOR CALCULATION OF REYNOLDS NUMBER AS A FUNCTION OF MACH NUMBER, STAGNATION PRESSURE, AND STAGNATION TEMPERATURE
D. J. Spring and K. L. Blackwell Feb. 18, 1963 89 p
(RF-TR-63-3)

The contents of this technical report were computed to aid in the rapid determination of Reynolds numbers under various conditions of wind-tunnel operation. Presented in the tables are Reynolds numbers as a function of the tunnel stagnation pressure, stagnation temperatures, and Mach number. The Mach number range is from 0.1 to 20 with a temperature range of from 0° to 2000° F. Author

N63-14301 European Office of Aerospace Research, Lausanne (Switzerland)
OUTLINE OF AN ALGEBRA OF STOCHASTIC QUANTITIES [Summary Report, Feb. 1960-Aug. 1962]
Waloddi Weibull Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 65 p
(Contract AF 61(052)-522)
(ASD-TDR-63-63)

The aim of the work reported has been to develop methods of solving random equations, that is, equations involving variates (random variables). The main difficulty of this task arises from the fact that no variate, if not degenerate, is invertible, or, algebraically expressed, even if the set V of variates is a commutative monoid under both addition and multiplication, it does not constitute a field. For this purpose a set S of elements, called stochastic quantitites (for brevity, stochastics), of which V is a subset, has been constructed with the property that it constitutes a field. This implies that there exists for every element of it an inverse element relative to both the additive and multiplicative laws of composition. Then, it becomes possible to compute with the stochastic quantities as easily as with rational numbers with respect to the four fundamental operations $+, -, \cdot, :$. Author

N63-14330 Ampex Corp., Redwood City, Calif.
HIGH DENSITY DIGITAL RECORDING I
S. Chao Feb. 1963 53 p 19 refs
(TR 62-12)

The theory of the record and the reproduce processes in pulse recording is discussed in terms of various controlling parameters. Recommendations are made for improving packing density, record resolution, and reproduce resolution. Various methods of binary recording are described and evaluated. Future trends in high-density digital-recording techniques and applications are predicted. Author

N63-14340 Minneapolis-Honeywell Regulator Co. Military Products Group, Minn.
ADAPTIVE STATE VECTOR CONTROL. SECTION 7: APPROXIMATIONS TO STATE VECTOR CONTROL
J. A. Lovingood May 31, 1962 53 p 11 refs
(NASA Contract NASr-27)
(MH-MPG-1529-TR-7) OTS: $5.60 ph, $1.79 mf

Approximation techniques are developed to permit optimal state vector controllers to be used for control of high order plants without inordinate complexity and cost. The methods are based on conventional cancellation compensation techniques. The effectiveness of the approximation methods is demonstrated by simulation results.
Author

N63-14352 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Strahlantriebe, Brunswick (W. Germany)
DIGITALER GEBER FÜR DREHZAHLMESSUNGEN (INSBESONDERE FÜR DAS TRIEBWERK MARBORÉ II) [DIGITAL INDICATOR FOR REVOLUTIONS PER MINUTE (ESPECIALLY FOR THE MARBORÉ II ENGINE)]
O. Lutz, F..v. Burger-Scheidlin, and P. Stottmann Aug. 1962 18 p 1 ref In German
(DFL-184)

A digital indicator for measuring revolutions per minute is described. This indicator works on the principle of induction. The bore sheath of a ferromagnetic circular disk is moved through an air gap of a ferrite core. This produces voltage impulses the frequencies of which are proportional to the number of revolutions measured. A Schmitt-Trigger transistor, built into the indicator, serves as the pulse shaper. An indicator which works on this principle was designed for the Marboré II engine. Construction and experimental results are described. The measuring range was 200 rpm to 25,000 rpm. The measurement accuracy was 0.05% ±2 rpm for a measuring time of one second. Trans. by I.v.L.

N63-14358 Harvard U., Cambridge, Mass.
TIME-INDEPENDENT PERTURBATION THEORY BY GAUGE TRANSFORMATIONS
Jeremy I. Musher [1962] 24 p 23 refs
(Supported by U.S. P.H.S. and Navy)

It is shown that a given solution ψ_o of a one-electron Schrödinger equation for Hamiltonian χ_o is also the solution to the Schrödinger equation for a particular gage-transformed Hamiltonian when any given perturbation $\eta\chi_1$ is added to χ_o. This transformation is obtained from solutions to inhomogeneous partial differential equations similar to those of Dalgarno and Schwartz, and it has the virtue of giving the energy expectation value in a particularly simple form. The corresponding many-electron gage-transformation is also treated, and despite the fact that the equations obtained are in general not exactly soluble, the procedure does provide a useful visualization of the electron correlation contributions to the energy. An approximation for multicenter wave functions, which amounts to choosing a different gage for each center, is also presented and the error introduced is discussed. Author

N63-14362 Geophysics Corp. of America, Bedford, Mass.
NOTE ON EQUATIONS FOR COMPUTING NUMBER DENSITY RATIOS FROM TEMPERATURE PROFILES Scientific Report No. 1
Lennart R. Peterson, Raymond A. Minzner, and Richard H. Harrison Feb. 1963 21 p 2 refs
(Contract AF 19(628)-1633)
(GCA TR-63-2-A; AFCRL-63-297)

Equations giving the number density ratios in an atmosphere characterized by nonzero linear temperature gradients and by an inverse-square law gravity field have been discussed previously. It is shown that these equations are, however, somewhat inconvenient to use in manual computations and cannot be handled properly by an electronic computer over certain regions of the atmosphere. A series solution which bypasses these difficulties, and which can be applied accurately over the entire altitude range of a diffusively separated atmosphere, has been derived. An iterative process in which the temperature profile is assumed linear in 5-km segments is described in terms of this series solution. It is therefore possible to compute number density ratios of some individual constituents in diffusive equilibrium in the upper atmosphere. Author

N63-14363 Geophysics Corp. of America, Bedford, Mass.
A POLYNOMIAL FIT TO THE DEFINING POINTS FOR MEAN MOLECULAR WEIGHT IN THE 1962 U. S. STANDARD ATMOSPHERE Scientific Report No. 2
Lennart R. Peterson and Raymond A. Minzner Feb. 1963 20 p 5 refs
(Contract AF 19(628)-1633)
(GCA-TR-63-4-A; AFCRL-63-298)

Polynomials have been fitted to the 14 data points for mean molecular weight, M(Z), computed by Champion as defining points for the "1962 U.S. Standard Atmosphere." One set of polynomials of relatively high order has been presented and then used to construct

a table of values for M(Z). The results represent in some respects a better fit to the defining points than the fit used in the 1962 standard atmosphere. In addition, several polynomials, (orders one, two, and three) have been given and are particularly useful for general computations. These low-order polynomials agree with the defining points to within about 1%. The mean molecular weight as defined in the 1962 standard atmosphere is questioned, however, in the light of new data involving atmospheric composition determinations. The new data indicate lower values of M(Z) than are given by the standard atmosphere at intermediate altitudes. Author

N63-14377 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.

A STATISTICAL THEORY OF FEEDBACK CONTROL

R. F. Drenick Dec. 28, 1962 45 p 9 refs
(Contract DA-ARO(D)-31-124-G144)
(PIBMRI-1108-62; AROD-1538-20)

This report deals with the problem of optimal feedback control. It emphasizes three issues: (1) the question of control in the presence of random disturbances and reference signals; (2) the problem of optimal control over long periods of time; (3) the question of when an optimal feedback-control system might properly be called adaptive, and to what extent the theory developed can be applied to the latter system type. In view of (1), the problem is formulated and treated as a probabilistic problem. Item (2) implies an emphasis on asymptotic results which, is, in fact, made. Item (3) suggests the necessity of a definition of an adaptive feedback system. Several results concerning these systems are given. Author

N63-14424 Wisconsin U., Madison

THE WHITTAKER-HILL EQUATION AND THE WAVE EQUATION IN PARABOLOIDAL COORDINATES Technical Summary Report

F. M. Arscott May 1962 42 p 12 refs
(Contract DA-11-022-ORD-2059)
(MRC-319)

The problem considered is that of obtaining solutions of the wave equation $\nabla^2 V + k^2 V = 0$ suitable for use in connection with paraboloidal coordinates; for example, when boundary conditions are given on a paraboloidal surface. In these coordinates the wave equation is separable, and each of the separated equations is reducible to Hill's equation with three terms. The properties of solutions of this equation are developed sufficiently to make possible the formal solution of simple boundary-value problems for paraboloidal surfaces in the case $k^2 < 0$, and a brief consideration is made of the case $k^2 < 0$, in which special difficulties occur. Author

N63-14425 Wisconsin U., Madison

TRANSITION THEORY OF CREEP RUPTURE Technical Summary Report

B. R. Seth July 1962 25 p 18 refs
(Contract DA-11-022-ORD-2059)
(MRC-321)

In existing literature two semiempirical assumptions are made to treat problems of creep and relaxation. The first is a creep law like that of Norton, Hoff, Kachanov or Odqvist. The second is a yield condition like that of Tresca or Von Mises. The first arises due to the use of linear strain measures and the second due to the neglect of an intermediate state between elastic and plastic deformation. The use of nonlinear generalized strain measures does away with the necessity of using the first. The identification of the transition state in elastic-plastic deformation with the turning points of the nonlinear differential equations arising out of the equations of equilibrium shows that the second may not also be used. Thus, a unified treatment of problems in creep and relaxation, bereft of a number of unnecessary laws and yield conditions, is obtained. The present treatment deals with only creep problems, but those relating to relaxation can be similarly dealt with. The case of a hollow tube subjected to internal pressure has been treated in detail, and it is found that the creep stresses are exactly of the forms as obtained by Kachanov. Author

N63-14433 Wisconsin U., Madison

ON THE ASYMPTOTIC BEHAVIOUR OF BESSEL FUNCTIONS Technical Summary Report

Fred Brauer Apr. 1962 9 p 4 refs
(Contract DA-11-022-ORD-2059)
(MRC-313)

A method for expressing the behavior of the Bessel function $J_n(x)$ in terms of trigonometric functions is discussed. This expression contains an amplitude and a phase angle, whose calculation requires writing $J_n(x)$ in terms of certain contour integrals in the complex plane and evaluating these integrals. This method will show that the resulting formula can be differentiated. Then the well-known recursion relations for Bessel functions can be used to calculate the amplitude and phase angle. Using only the Bessel differential equation and the recursion relations, the asymptotic formula can be established and the amplitude and phase angle for $J_n(x)$ can be expressed in terms of the amplitude and phase angle for $J_0(x)$. Since the amplitude and phase angle for $J_0(x)$ can be found be evaluating one real definite integral, the problem is then completely solved. I.v.L.

N63-14453 Wisconsin U., Madison

TAUBERIAN THEOREMS Technical Summary Report

José M. Gonzáles-Fernandez June 1962 53 p 6 refs
(Contract DA-11-022-ORD-2059)
(MRC-324)

The classical tauberian theorem for power series of Hardy and Littlewood is generalized to the case where instead of power series one deals with series of the type $\Sigma c_n \int_0^x \psi\left(\frac{1}{1-t}\right) t^n\, dt$ where $\psi(y)$ is a logarithmico-exponential function in the sense of Hardy. We prove in this paper that if γ the order of growth of $\psi(y)$ as $y \to \infty$ is such that $0<\gamma<1$, and if the asymptotic behavior of $\Sigma c_n \int_0^x \psi\left(\frac{1}{1-t}\right) t^n\, dt$ as $x \uparrow 1$ is known in terms of another function $\phi(y)$ of logarithmico-exponential type, then the asymptotic behavior of the partial sums of $\Sigma c_n \int_0^1 \psi\left(\frac{1}{1-t}\right) t^n\, dt$ is also known, and it is given in a simple manner by $\phi(y)$. The tauberian condition needed is a one-sided O-condition given in terms of the quotient $\phi(n)/\psi(n)$. When the function $\psi\left(\frac{1}{1-t}\right)$ is of the form $(1-t)^{-\gamma}$ then one obtains precise information about the asymptotic behavior of the partial sums of $\Sigma c_n n^{\gamma-1}$. A study is made of the case when γ is larger than one and noninteger so that $\lim_{p \uparrow 1} \int_0^p \psi\left(\frac{1}{1-t}\right) dt$ does not exist. For this case, and under some suitable subsidiary conditions, one can obtain information about the asymptotic behavior of the partial sums of $\Sigma c_n n^k \int_0^1 (1-x)^k \psi\left(\frac{1}{1-x}\right) x^n\, dx$ where k is such that $K<\gamma<k+1$. For these cases, the tauberian condition is formally the same as above. The subsidiary conditions needed are discussed, and they are shown to depend on the order of growth of the quotient $\phi(y)/\psi(y)$ as $y \to \infty$. Author

N63-14455 Wisconsin U., Madison

NEUMANN-SERIES SOLUTIONS OF THE ELLIPSOIDAL WAVE EQUATION Technical Summary Report

F. M. Arscott July 1962 20 p 6 refs
(Contract DA-11-022-ORD-2059)
(MRC-327)

The ellipsoidal wave equation (or Lamé wave equation) is the name given to the ordinary differential equation which arises when

the wave equation is separated in ellipsoidal coordinates. Solutions of the equation are expressed as Neumann series (series of Bessel functions of increasing order). Author

N63-14456 Wisconsin U., Madison
A TWO-BODY PROBLEM OF CLASSICAL ELECTRODYNAMICS: THE ONE-DIMENSIONAL CASE Technical Summary Report
Rodney D. Driver July 1962 37 p 9 refs
(Contract DA-11-022-ORD-2059)
(MRC-332)

The equations of motion for the two-body problem of classical electrodynamics can be formulated by substituting the expressions for the field of a moving charge, calculated from the Liénard-Wiechert potentials, into the Lorentz-Abraham force law. In this paper, radiation reaction is omitted and the charges are assumed to move along the x-axis. Due to the finite speed of propagation, c, of electrical effects, the differential equations involve time delays, which depend upon the unknown trajectories. Thus the equations of motion are not ordinary differential equations, and one does not determine a unique solution for $t \geq t_0$ by merely specifying the positions and velocities of the charges at t_0. One specifies rather arbitrary initial trajectories of the two charges over some appropriate interval $[\alpha, t_0]$, where $\alpha < t_0$. Under suitable conditions, one can then show the existence of a unique extension of these trajectories which satisfy the equations of motion for all $t > t_0$ unless and until the charges collide. Moreover, the solution depends continuously on the given initial trajectories. It is also shown that two point charges of like sign cannot collide, while two point charges of opposite signs may or may not collide, depending upon the initial data. In the event of a collision, the velocities of the two charges become +c and -c at the instant of collision. The effect of an external electric field in the x-direction is also considered. Author

N63-14457 Wisconsin U., Madison
INERTIA THEOREMS FOR MATRICES: THE SEMI-DEFINITE CASE Technical Summary Report
David Carlson and Hans Schneider July 1962 28 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-342)

Generalizations and applications of the Main Inertia Theorem for Matrices are discussed in the case $R(AH) \geq 0$. In two special cases the relation between In H and In A is determined. It is shown that for all A there exists a nonsingular Hermitian H such that $R(AH) \geq 0$ and a necessary and sufficient condition is given for the existence of $H > 0$ for which $R(AH) \geq 0$. For a given subspace N, conditions are found for the existence of a Hermitian K such that $R(AK) \geq 0$ and $N = N(K) = N(R(AK))$. (Here $N(K)$ is the null-space of K). If such a K exists, further conditions are found under which $N(H) = N$ for all Hermitian H with $R(AH) \geq 0$ and $N(R(AH)) = N$. An effective test is given for the H-stability of a matrix A. Author

N63-14458 Wisconsin U., Madison
REVIEW OF EXTENSIONS OF INTEGRAL-TYPE FUNCTIONALS Technical Summary Report
W. Slowikowski Jan. 1962 22 p 4 refs
(Contract DA-11-022-ORD-2059)
(MRC-240)

The classical problem of extension of the integral for linear spaces with an ordering relation is examined in terms of linear lattices language because it then becomes easier to follow these properties of a functional on a sublattice that guarantee the existence of suitable extension to the whole lattice. The linear lattice language was also applied to extensions of linear functions, continuous functions, Riemann-type integrals, and upper, lower, and L-integrals. D.E.R.

N63-14459 Wisconsin U., Madison
ON A CLASS OF SINGULAR INTEGRAL EQUATIONS Technical Summary Report
H. F. Bueckner Feb. 1962 54 p 7 refs
(Contract DA-11-022-ORD-2059)
(MRC-278)

Attempted solutions v(t), belonging to some class $L_q(0,1)$ with $q > 1$ are sought for the integral equation

$$\frac{1}{\pi}\int_0^1 \frac{v(t)dt}{t-x} + \sum_{k=1}^{n} a_k \int_0^1 \frac{t^{k-1}v(t)dt}{(t+x)^k} = g(x),\ 0<x<1$$

with real valued constant coefficients a_k and a real valued function g(x) belonging to a certain class $L_p(0,1)$ with $p > 1$. A.R.B.

N63-14460 Wisconsin U., Madison
ON A CLASS OF LINEAR DIFFERENCE-INTEGRAL EQUATIONS Technical Summary Report
P. M. Anselone and D. Greenspan Feb. 1962 46 p 13 refs
(Contract DA-11-022-ORD-2059)
(MRC-292)

Certain classes of complex functions, phi, associated with "shift-invariance," are discussed as in the Laplace transforms. Methods of functional analysis are employed, and these are compared to the Laplace transform method. Equations with equally spaced intervals are solved; but, by analogy, more complicated, unequally spaced interval equations can be solved by this method. D.E.R.

N63-14461 Wisconsin U., Madison
THE SECOND SOLUTION OF LAMÉ'S EQUATION Technical Summary Report
F. M. Arscott Apr. 1962 29 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-309)

All the known results relating to the second (nonperiodic) solution of Lamé's equation, and some new results, including two categories of integral representation, are summarized. Results are given for the eight polynomial types possible when n is an integer and h has one of the 2n+1 characteristic values which has a Lamé polynomial as first solution. Various normalizations are possible from the solutions given. D.E.R.

N63-14463 Wisconsin U., Madison
SINGULARITIES OF A HARMONIC FUNCTION OF THREE VARIABLES GIVEN BY ITS SERIES DEVELOPMENT Technical Summary Report
Alvin M. White Apr. 1962 29 p 15 refs
(Contract DA-11-022-ORD-2059)
(MRC-312)

The relations between singularities of harmonic functions and of analytic functions are analyzed to determine the criteria for a harmonic function to have certain singularities. Using the Bergman operator, an analytic function is transformed into a harmonic function of three real variables. Some theorems relating subsequences of coefficients of a series development of this function are proved along with possible singularity curves. It is further proved that the harmonic function represented by a Bergman operator of a certain general form also satisfies a system of ordinary linear differential equations. A special case of this result is discussed. R.C.M.

N63-14467 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ALGEBRA OF PERIODIC SEQUENCES
R. C. Titsworth Jan. 7, 1963 53 p 12 refs
(NASA Contract NAS7-100)
(JPL-TR-32-381) OTS: $5.60 ph, $1.79 mf

The set of periodic sequences over a field forms a group-ring algebra in which convolution is the product operation. Decomposition theorems are applied to this ring to aid in finding sequences with an arbitrary, specified autocorrelation function. Author

N63-14472 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N. J.

GENERAL DESCRIPTION AND BASIC LOGIC OF THE UNIVAC FILE COMPUTER I AIR TRAFFIC CONTROL/AUTOMATIC DATA PROCESSING SYSTEM Final Report

Kenneth W. House, Don W. Vogel, Raymond J. Hilton, and Michael Mc Cory Apr. 1962 112 p 6 refs

This report provides a general description and the basic logic for an air-traffic-control automatic data-processing program. This document was written without reference to a specific computer and in sufficient detail to permit a person of limited background in air-traffic control and computer programing to understand the processing methods and logic employed. Author

N63-14473 Wisconsin U., Madison

EXISTENCE AND STABILITY OF SOLUTIONS OF A DELAY-DIFFERENTIAL SYSTEM Technical Summary Report

Rodney D. Driver Apr. 1962 52 p 21 refs
(Contract DA-11-022-ORD-2059)
(MRC-300)

The basic existence and uniqueness theorems for a difference-differential system of equations and a generalized introduction to the Liapunov method for these equations are given. These equations (called differential equations with retarded argument in Russian literature) have received much attention in Russia, apparently because of the importance of such systems in automatic control theory. Stability definitions, Liapunov's direct method for stability, and the use of Liapunov functionals and functions in asymptotic theorems are presented with proofs and examples culled from Russian sources. M.P.G.

N63-14475 Wisconsin U., Madison

DIFFRACTION OF PULSES BY A HALF-PLANE, PART I Technical Summary Report

Michael Papadopoulos Feb. 1962 32 p 7 refs
(Contract DA-11-022-ORD-2059)
(MRC-293)

Another approach in solving the problem of diffraction of pulses by a half-plane is presented. The solution is derived from the elementary solution of two- and three-dimensional wave equations in the form of continuous distributions of singular plane waves. The Friedlander solution for the diffraction of plane pulses is discussed and expanded to include complex waves. A self-consistent derivation, identifiable with known solutions, and usable in more general diffraction problems, is given. The delta function is important to all these calculations and is derived for p and q parameter values of less than 1 and for more complex values. D.E.R.

N63-14477 Wisconsin U., Madison

DIFFRACTION BY A REFRACTING WEDGE Technical Summary Report

Michael Papadopoulos Mar. 1962 46 p 6 refs
(Contract DA-11-022-ORD-2059)
(MRC-297)

A method is presented which leads to a complete, unique formulation for the diffracted field which arises in a wedge-shaped region when there is a plane material discontinuity passing through the vertex. The formulation has proved that the edge singularity in each wedge depends only on the angle and not on the material properties of the two wedges. Also, derived from the formulation was the implication that the high and low frequency diffracted fields of harmonic time dependence may be found in series form, after an application of Duhamel's theorem to obtain a steady-state solution from a pulse solution. A.R.B.

N63-14478 Wisconsin U., Madison

BOUNDARY VALUES OF ANALYTIC VECTOR VALUED FUNCTIONS Technical Summary Report

Robert Ryan Mar. 1962 30 p 4 refs
(Contract DA-11-022-ORD-2059)
(MRC-303)

Statements are made for a complex valued function, and their equivalence condition is defined. It is then shown how these statements must be modified in order to establish their equivalence when the function becomes a vector valued function, e.g., has values in the dual of a separable Banach space. The results are applied to operator valued functions. R.C.M.

N63-14479 Wisconsin U., Madison

THE CONSTRUCTION OF RELATED EQUATIONS FOR THE ASYMPTOTIC THEORY OF LINEAR ORDINARY DIFFERENTIAL EQUATIONS ABOUT A TURNING POINT Technical Summary Report

Rudolph E. Langer Mar. 1962 31 p 6 refs
(Contract DA-11-022-ORD-2059)
(MRC-305)

A related equation is constructed for the asymptotic theory of linear ordinary differential equations about a turning point. The related equation, whose solutions are completely derived, has coefficients which differ from those of the given equation, $L(u) = 0$, by terms that are at least of the r^{th} degree in $1/\lambda$. M.P.G.

N63-14480 Wisconsin U., Madison

PROPERTIES OF SOLUTIONS OF ABSTRACT DIFFERENTIAL INEQUALITIES Technical Summary Report

V. Lakshmikantham July 1962 17 p 12 refs
(Contract DA-11-022-ORD-2059)
(MRC-334)

Many properties concerning the behavior of solution of ordinary differential equations can be made to depend on a scalar differential equation. Comparison principle of this type has been widely used. Using similar approach, we consider some properties of solutions of abstract differential inequalities of the type $|x' - A(t)x - f(t,x)| \leq W_1(t,|x|)$ where $A(t)$ is a given function whose values are linear operators acting in a Banach space. We obtain estimates of the norm of solutions, and also consider stability and boundedness results. A general uniqueness theorem for abstract differential equations is also included. Author

N63-14495 Los Alamos Scientific Lab., N. Mex.

COMPUTER DATA PROCESSING SYSTEM. PROJECT ROVER, 1962

Francis Narin Mar. 13, 1963 176 p
(Contract W-7405-eng-36)
(LAMS-2845)

A system has been created for the processing, at the Los Alamos Scientific Laboratory, of large volumes of data from Project ROVER tests at the Nevada Test Site. The data are brought to Los Alamos as as analog frequency modulated tape, which is translated in a Packard-Bell Tape-to-Tape converter into a binary coded decimal (BCD) IBM 7090 computer input tape. This input tape, tape A5, is processed on the 7090 by the RDH-D FORTRAN-II code and its 20 FAP and FORTRAN subroutines. Outputs from the 7090 run are tapes A3, which is a BCD tape used for listing on the IBM 1401 input-output computer, tape B5 which is a binary tape used as input to a Stromberg-Carlson 40/20 cathode ray tube (CRT) plotter, and tape B6 which is a binary tape used for permanent data storage and input to specialized subcodes. The information on tape B5 commands the 40/20 to write grids, data points, and other information on the face of a CRT; the information on the CRT is photographed on 35-mm film which is subsequently developed; full-size (10" x 10") plots are made from the 35-mm film on a Xerox 1824 printer. The 7090 processes a data channel (each individual measurement is a data channel)

in approximately 4 seconds plus 4 seconds per plot to be made on the 40/20 for that channel. Up to 4500 data and calibration points on any one channel may be processed in one pass of the RDH-D code. Author

N63-14503 Deutsche Versuchsanstalt für Luft- and Raumfahrt. Inst. für Flugfunk and Mikrowellen, Oberpfaffenhofen (W. Germany)
GEWÖHNLICHE DIFFERENTIALGLEICHUNGEN 1. ORDNUNG [ORDINARY DIFFERENTIAL EQUATIONS OF THE FIRST ORDER]
Ludwig Harmann Sept. 1962 130 p In German
(DVL-239)

Standard differential equations of the first order are discussed and a number of examples are given. A detailed discussion is presented on the multiple correlation and interrelation between the concept of the functions of one and two independent variables. This approach differs from the textbook treatment of differential equations wherein the interrelation is assumed. A special treatment seems justified, however, due to the fact that in the differential equation $y' = f(x,y)$, f is a function of the two independent variables, whereas in the solution of the equation, it is a function of only one of the variables. Due to the special characteristic of the function $f(x,y)$, the methods of solution are predetermined so that only a few differential equations can be directly integrated. In contrast, the methods of successive approximation, which are necessary in proving the theory of the existence of a unique solution, have a much more extended scope of application. The implicit differential equation of the first order $F(x,y,y') = 0$ includes the explicit differential equation $y' = f(x,y)$ as a special case and requires algebraic laws and methods for its solution. With the help of algebra, the solution of an implicit differential equation can be reduced to the solution of an explicit differential equation. Special types of singular solutions of implicit differential equations are discussed. Trans. by I.v.L.

N63-14505 Wisconsin U., Madison
INITIAL-BOUNDARY VALUE PROBLEMS FOR LINEAR HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS OF THE SECOND ORDER Technical Summary Report
Calvin H. Wilcox Mar. 1962 81 p 21 refs
(Contract DA-11-022-ORD-2059)
(MRC-301)

A complete and self-contained treatment of initial-boundary value problem is given for a class of linear, hyperbolic, partial-differential equations of the second order. The equations derived are an extension of the mathematical theory of diffraction. The relation of these equations to the existing theory is discussed to point out the principal results of the new theory as follows: existence and uniqueness theorems for solutions with locally finite energy, existence theorems for strict solutions, and the domain of dependence inequality. The existence of higher order derivatives for the strict solutions is indicated. R.C.M.

N63-14506 Wisconsin U., Madison
SOME RESULTS IN DELAY-DIFFERENTIAL EQUATIONS Technical Summary Report
V. Lakshmikantham Mar. 1962 21 p 10 refs
(Contract DA-11-022-ORD-2059)
(MRC-306)

Many problems concerning the behavior of solutions of ordinary differential equations can be made to depend on a scalar differential equation. Since one has to deal with functionals instead of functions in delay-differential equations, a problem is to select a minimal set of functions along which the assumptions are to be satisfied. Using the idea of Razumikhin, the study of delay-differential equations has been reduced to the study of a scalar differential equation and thus many known results for differential equations have been extended to delay-differential equations. For example, the results cover uniqueness, global existence, upper and lower bounds of the norm of solutions, limiting behavior, stability and boundedness of perturbed and unperturbed systems. The equations considered here are so general as to include various types of differential equations with a retarded argument and ordinary differential equations as special cases. I.v.L.

N63-14507 Wisconsin U., Madison
THE ROLE OF CONSTRAINTS IN THE THEORY OF LEAST SQUARES Technical Summary Report
M. Zelen May 1962 47 p 14 refs
(Contract DA-11-022-ORD-2059)
(MRC-314)

This paper presents a unified account of the theory of least squares, and, in particular, describes the necessary modifications when linear restraints are imposed on the parameters. The development has been greatly influenced by the use of a "generalized inverse" of a matrix which, in turn, leads to interesting new proofs of standard results and to some new results. The treatment distinguishes between restraints imposed for the purpose of obtaining unique solutions and real restraints. It is necessary to take into account whether the real restraints are estimable or nonestimable functions. Applications of the general theory are made to the case of equicorrelated variables (correlation unknown), the general case of a singular variance-covariance matrix among the observations, and to the case where linear restraints are subject to random error. Author

N63-14508 Wisconsin U., Madison
DIFFERENTIAL EQUATIONS IN BANACH SPACES AND THE EXTENSION OF LYAPUNOV'S METHOD Technical Summary Report
V. Lakshmikantham Apr. 1962 20 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-315)

Liapunov's method is extended to study some problems of differential equations in Banach spaces. The results cover (1) bounds of the norm of solutions and approximate solutions, (2) global existence, (3) stability, and (4) boundedness of a set. M.P.G.

N63-14509 Wisconsin U., Madison
MULTIPLE SCATTERING OF PLANE WAVES BY TWO ELLIPTIC CYLINDERS Technical Summary Report
N. Zitron May 1962 33 p 21 refs
(Contract DA-11-022-ORD-2059)
(MRC-316)

An asymptotic solution is obtained for the problem of diffraction of a plane wave by two parallel, infinite, widely spaced elliptic cylinders. The solution is a special case of a previous result for cylinders of arbitrary shape. Elliptic cylinders are of special interest because diffraction by an elliptic cylinder is the most general separable two-dimensional exterior-boundary problem for the wave equation and because a convex cylinder can be approximated by an elliptic cylinder. The far field is given in terms of the Mathieu function solutions obtained for diffraction of a plane wave by a single elliptic cylinder and in terms of the spacing d up to terms of order $d^{-3/2}$. The cases of collinear major and minor axes are considered. Scattering cross sections are calculated in both cases. The results show how the Mathieu function solutions for the individual cylinders are modified when they are combined and, consequently, combinations of elliptic cylinders have filtering properties which depend on the orientations of the cylinders. Author

N63-14510 Wisconsin U., Madison
THE EXTENSION PROBLEM FOR POSITIVE-DEFINITE FUNCTIONS Technical Summary Report
Walter Rudin May 1962 19 p 7 refs
(Contract DA-11-022-ORD-2059)
(MRC-317)

The extension problem for positive-definite functions on euclidean spaces and on groups of lattice points is given. A finite set S in a discrete group G is considered, and it is shown that the extension problem can be rephrased as the problem of representing certain positive trigonometric polynomials on the dual group of G as sums of squares. These considerations are further used to prove that the extension problem always has a solution if $G = Z$, the additive group of all integers, and if S is a finite arithmetic progression in Z. A result for trigonometric polynomials on the 2-dimensional torus T^2 is derived using the theorem of Hilbert which states that there exist positive polynomials of two real variables which are not sums of squares of polynomials. This result proves that the extension problem may fail to have a solution if $G = Z^2$, the group of all lattice points in the plane, and if S is a square of lattice points (with at least 16 points). A.R.B.

N63-14512 Wisconsin U., Madison

NOTE ON DIFFERENCE APPROXIMATIONS WITH NON-NEGATIVE COEFFICIENTS FOR PARTIAL DIFFERENTIAL EQUATIONS Technical Summary Report

Donald Greenspan May 1962 18 p 3 refs
(Contract DA-11-022-ORD-2059)
(MRC-323)

On region R, the linear operator

$$L[u(x,y)] \equiv u_{xx} + 2b(x,y)u_{xy} + c(x,y)u_{yy},\ c(x,y) > 0,$$

is considered. Conditions are sought under which at $(\bar{x}, \bar{y}) \in R$, L has a difference approximation $L_h[u] \equiv \sum_{i=0}^{8} \alpha_i u_i$ with nonnegative coefficients. If b and c are continuous and $u \in C^2(R)$; or, essentially, if b and c are analytic and u is a solution of $L[u] = 0$, then it is proved that a necessary and sufficient condition for L_h to exist is that $|b(\bar{x},\bar{y})| \leq \min[1, c(\bar{x},\bar{y})]$. When the latter inequality is valid, L_h is given constructively. Application is made to an extension of a numerical method of Bers for mildly nonlinear elliptic differential equations. Author

N63-14513 Wisconsin U., Madison

BANACH FUNCTION SPACES OF VECTOR VALUED FUNCTIONS Technical Summary Report

Robert Ryan June 1962 52 p 24 refs
(Contract DA-11-022-ORD-2059)
(MRC-328)

This paper discusses the study of Banach spaces, the elements of which are classes of measurable functions defined on a locally compact Hausdorff space with values in a fixed Banach space. The norms of the spaces studied are expressed in terms of length functions defined for positive measurable functions. It is shown how certain properties of the length function and the range space of the vector-valued functions are reflected in the Banach-function space. A representation is established of the dual spaces of these Banach-function spaces in certain cases. Author

N63-14514 Wisconsin U., Madison

APPLICATIONS OF THE CALCULUS OF FACTORIAL ARRANGEMENTS I: BLOCK AND DIRECT PRODUCT DESIGNS Technical Summary Report

B. Kurkjian (Diamond Ord. Fuze. Labs.) and M. Zelen July 1962 58 p 14 refs
(Contract DA-11-022-ORD-2059)
(MRC-330)

This paper applies an operational calculus for factorial arrangements to the analysis of randomized block, balanced incomplete block, group divisible and many direct product designs. Author

N63-14515 Wisconsin U., Madison

ASYMPTOTIC SOLUTIONS OF A NONHOMOGENEOUS DIFFERENTIAL EQUATION WITH A TURNING POINT Technical Summary Report

R. A. Clark July 1962 38 p 14 refs
(Contract DA-11-022-ORD-2059)
(MRC-331)

A linear second-order differential equation of the form

$$(1)\ d^2U/dt^2 + [\lambda^2 \phi(t) + \lambda\chi(t,\lambda)]U = \lambda^2 \psi(t,\lambda)$$

is considered with the real variable t ranging over a finite closed interval. The parameter λ is assumed to be large and complex-valued and the real-valued function ϕ is assumed to have a single zero of first order, known as a turning point. Assuming that χ and ψ are analytic in λ for $|\lambda| > \lambda_0 > 0$ and that ϕ, χ, and ψ are infinitely differentiable in t, two types of formal solutions are constructed in terms of a solution of the differential equation (2) $S''(z) + z\,S(z) = 1$. Properties of solutions of (2) are established and it is shown that, when λ lies in a given quadrant of the λ-plane, S can be chosen so that the formal solutions furnish asymptotic representations of actual solutions of (1) provided λ is sufficiently large. Author

N63-14576 Naval Ordnance Lab., White Oak, Md.

A FORTRAN III (IBM 7090) PROGRAM FOR THE CALCULATION OF ELECTRON WAVE FUNCTIONS FOR THE SODIUM ION

Gerhard Heiche Mar. 1963 42 p
(Math. Dept. Rept. M-34; NOLTR-63-31)

An IBM-7090 program is described. It calculates, using simplified Hartree-Fock equations, the radial parts of the wave functions for the electrons in the sodium ion. Up to 1000 values of each wave function can be calculated. A complete listing of the subroutines and an example are included. Author

N63-14583 Wisconsin U., Madison

THE HEURISTICS OF DATA TRANSFORMATION Technical Summary Report

H. E. Reinhardt Feb. 1963 17 p 9 refs
(Contract DA-11-022-ORD-2059)
(MRC-355)

Suppose $\{X_n\}$ is a sequence of random variables (r.v.s) with means μ_n and variances $f_n(\mu_n)$. Attempts to find r.v.s $T_n = T_n(X_n)$ with approximately constant variance have focused on r.v.s of the form

$$(1)\qquad T_n(X_n) = \int_{\mu_n}^{X_n} \frac{1}{\sqrt{f_n(t)}}\,dt.$$

Curtiss proved a fundamental theorem which gave a sound theoretical basis for transformations of the form (1). This paper gives several generalizations and applications of Curtiss' theorem. Author

N63-14584 Wisconsin U., Madison

A NUMERICAL INVESTIGATION OF SCATTERING OF RADIATION OF AN ASYMMETRIC SOURCE BY CIRCULAR CYLINDER Technical Summary Report

N. Zitron and J. Davis Mar. 1963 35 p 16 refs
(Contract DA-11-022-ORD-2059)
(MRC-365)

An asymptotic expansion obtained previously is employed to explore the limits of validity of plane wave and line source assumptions for the incident wave, in the problem of scattering of waves by an infinite cylinder. Detailed numerical calculations are made in the cases where the incident wave is a plane wave, line source radiation, and slotted cylinder radiation. Curves are presented showing the variation of the amplitude of the scattered wave with respect to spacing of the source and scatterer. The effect of the directivity of a source is discussed. Author

N63-14592 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.

COMPUTER SOLUTION OF SIMULTANEOUS DIFFUSION—CHEMICAL KINETICS EQUATIONS RELATING TO UPPER ATMOSPHERE RELEASES Research Report

D. Golomb and J. Mason (RCA) Dec. 1962 26 p 5 refs
(AFCRL-62-1132)

An analog computer program is outlined for the solution of a set of simultaneous partial differential equations relating to the dynamic and chemical kinetics behavior of a chemical released into the upper atmosphere. Numerical examples are given for a Gaussian and pseudo-square-well model with single and two-step chemical reactions. Author

N63-14593 Wisconsin U., Madison

ON CONTINUED FRACTION EXPANSIONS FOR BINOMIAL QUADRATIC SURDS—COMPUTATION ON COMPUTERS Technical Summary Report

E. Frank Mar. 1963 22 p 3 refs
(Contract DA-11-022-ORD-2059)
(MRC-363)

The computation of continued fraction expansions for binomial quadratic surds, through the use of automatic digital computers, is discussed. The use of an electronic computer is especially convenient for this type of computation since the operations are repeated many times for many combinations of the various values of the parameters. A demonstration is presented of the use of computers in problems in numerical analysis—particularly, fractions and number theory. Very few such applications have been made thus far. Consequently, they are important since they show how extensions are possible in applications of the continued fraction theory in functional analysis, and in the approximations of functions by rational fractions through the use of continued fractions. I.v.L.

N63-14605 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.

COMPATIBILITY EVALUATION OF DATA HANDLING SUBSYSTEM Research Note

H. R. Howe, P. I. Hershberg, W. G. Weppner, and J. R. Griffin Dec. 1962 55 p 5 refs
(AFCRL-62-1108)

This report discusses an integrated high-speed data-handling subsystem designed to accommodate weather information. The subsystem utilizes standard telephone data circuits at speeds of 1000 through 2400 bits-per-second. The report indicates the results of an evaluation of equipments especially developed to accommodate the high-speed transmission function. These devices include: a master control station, a data selection unit, data transmitters, and data receivers. Author

N63-14609 Los Alamos Scientific Lab., N. Mex.

THE SOLUTION OF THE GENERAL LEAST SQUARES PROBLEM WITH SPECIAL REFERENCE TO HIGH-SPEED COMPUTERS

R. H. Moore and R. K. Zeigler Mar. 4, 1960 94 p refs
(Contract W-7405-eng-36)
(LA-2367) OTS: $2.25

The general problem of least squares analysis is discussed. Special emphasis is placed on functions in which the parameters appear nonlinearly and which can be fitted by Gauss' well-known iterative method. The procedure is useful with any type of computing facility. A family of FORTRAN II subroutines which solves problems with this method is presented. Particular attention has been given to making the subroutines convenient for the casual, nonprofessional programer for whom the high-speed computer is only a highly efficient tool. Several examples of functions fitted by the method are given. Author

N63-14615 California U., Los Angeles

BIBLIOGRAPHY ON MEROMORPHIC FUNCTIONS

Phillip Emig Mar. 14, 1963 93 p 739 refs
(Grant DA-ARO(D)-31-124-G40)
(AROD-1517-51; Tech. Rept. 32)

A bibliography of meromorphic functions is presented. This bibliography is international in scope. I.v.L.

N63-14623 Cornell Aeronautical Lab., Buffalo, N.Y.

A STUDY OF FINITE-DIFFERENCE METHODS AS APPLIED TO HYPERSONIC, VISCOUS SHOCK-LAYER EQUATIONS

A[ngela] L. Chang and H[siu] K. Cheng Mar. 1962 42 p 15 refs
(Contract Nonr-2653(00))
(Cal-AF-1285-A-9)

The problem of numerical integration of the parabolic differential equations of viscous shock-layer theory are studied. Three methods are considered: the standard explicit and implicit schemes, as well as the explicit scheme of DuFort and Frankel. The relative merit and efficiency of these methods are discussed in terms of numerical solutions carried out for the shock layer on a cone. Because of the singularity in the governing equation, the mesh size associated with the difference approximation must be progressively refined as the leading edge is approached. This, in practice, places a severe handicap on all difference methods, particularly the explicit scheme which is already restricted by the requirement of stability. The examples worked out here for flows over cones confirm that the implicit and DuFort-Frankel explicit schemes, which are not subject to the stability requirement, are more effective. Although the difference between the two latter schemes is not large in this example, the discussion reveals that the implicit scheme, which is subject to neither the stability nor the convergence requirement, is much more efficient and accurate in problems involving nonvanishing pressure gradients. Author

N63-14629 Lockheed Missiles and Space Co., Sunnyvale, Calif.

SOME FORMULAS INVOLVING PRODUCTS OF TRIGONOMETRIC FUNCTIONS SPACED AT REGULAR INTERVALS. COMMUNICATIONS Technical Report

Martin Blumberg Dec. 1962 111 p 6 refs
(LMSC-6-90-62-125)

In the study of infinite arrays of line charges, there arise functions of the complex variable $z = x + jy$ involving products of trigonometric functions spaced at regular intervals. It has been found that these formulas can be reduced to a constant times the function of a multiple angle. The two basic formulas in which the constants are $(-\frac{1}{2})^{n-1}$ and $(\frac{1}{2})^{n-1}$ follow:

$$\left(\frac{-1}{2}\right)^{n-1} \sin nz = \prod_{m=1}^{n-1} \sin\left(z - \frac{m\pi}{n}\right)$$

$$\left(\frac{1}{2}\right)^{n-1} \cos nz = \prod_{m}' \cos\left[z \pm \frac{\pi}{2}\left(1 - \frac{m}{n}\right)\right],$$

where m and n are positive integers, and in the second product m = odd = 1, 3, 5, ... $\leq$ n. Both the + and - sign are used in the second product; however, if n is odd, the value m = n is used only once, this fact being indicated by the prime on the Π. Other formulas which may be of interest are derived from these. A compilation of the important formulas derived in the text, together with examples, is given in the appendix. Author

N63-14642 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Inst. für Festigkeit, Mülheim an der Ruhr (W. Germany)

EIN BEITRAG ZUR FRAGE SUBHARMONISCHER LÖSUNGEN NICHTLINEARER SCHWINGUNGSGLEICHUNGEN [ONE CONTRIBUTION TO THE QUESTION OF SUBHARMONIC SOLUTIONS OF NONLINEAR OSCILLATION EQUATIONS]

W. Thielemann and G. Kotowski Feb. 1963 78 p 9 refs In German
(DVL-260)

A typical periodic solution is given for the Duffing differential equation (an equation of motion in a system of one degree of freedom with a solid cubic deflection property and harmonic excitation). The fundamental frequency of this solution is the m^{th} portion of the frequency of excitation. Its period is, therefore, an m-fold multiple of the frequency of excitation. The Fourrier development of this solution shows a very strongly defined higher n^{th} harmonic; thus one can characterize this solution by means of the fractions n/m. Numerical investigations were made for two different values of the excitation amplitude for the solution types $n/m = 2/3, 4/3$, and $5/3$.

Trans. by I.v.L

N63-14651 General Electric Co. Flight Propulsion Lab. Dept., Evendale, Ohio

COMPUTER PROGRAMS DESCRIBING COLLISION CASCADES IN BINARY MATERIALS. I. SQUARE PLANAR LATTICE

D. G. Besco and J. R. Beeler, Jr. Feb. 1963 40 p 5 refs
(Contract AT(40-1)-2847)
(GEMP-192) OTS: $1.00

An IBM-7090 computer program calculates the results of the bombardment of a square planar lattice of binary material by a single atom of specified type, position, direction, and energy. The hard-sphere model is used to compute the results of collisions. The collision radii are based on the Bohr screened coulomb potential. The computer records the entire history of the bombarding particle and all knock-ons, and prints a map of the defect configuration after the collision cascade, showing the location of all vacancies and interstitials.

Author

N63-14656 Boeing Scientific Research Labs. Mathematics Research Lab., Seattle, Wash.

PROPERTIES OF PROBABILITY DISTRIBUTIONS WITH MONOTONE HAZARD RATE

Richard E. Barlow, Albert W. Marshall (Inst. for Defense Analysis), and Frank Proschan Jan. 1962 45 p 18 refs
(Math. Note-247; D1-82-0148)

Properties of distribution functions, F (or their densities, f), are related to properties of the corresponding hazard rate, q, which is defined by $q(x) = f(x)/|1 - F(x)|$. Particular attention is paid to densities with monotone hazard rate. Applications to renewal processes are made by using the fact that the increasing hazard rate propety is preserved under convolution. Analogous results are obtained for discrete distributions.

A.R.B.

N63-14711 Los Alamos Scientific Lab., N. Mex.

THE BOUNDING OF INSTABILITIES OF THE PIC DIFFERENCE EQUATIONS

Bart J. Daly Mar. 27, 1963 62 p 4 refs
(Contract W-7405-eng-36)
(LA-2414) OTS: $1.50

A study is made of the effect of a nonlinearity on the stability properties of a simplified version of the PIC difference equations. An equilibrium amplitude of the fluctuations, resulting from the instability, is determined as a function of the parameters of the method.

Author

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-14378 RAND Corp., Santa Monica, Calif.

A MODEL OF THE ANNUAL TEMPERATURE VARIATIONS AT 30° N AND 60° N BETWEEN 30 AND 50 KM

E. S. Batten Mar. 1963 38 p 15 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3564-PR)

The meteorological data from rocket grenade observations and the Meteorological Ricket Network are summarized. Using the temperature data and temperature gradients computed from wind shears, a model was constructed of the seasonal variations of temperature at 30° N and 60° N. At 30° N the observations indicate a tendency for two temperature maxima annually. A statistical analysis of the data at 30° N shows the significance of the seasonal variations at 35 and 40 km. The temperature variation at 60° N has a single summer maximum and a larger amplitude than at 30° N. The largest latitudinal differences occur during winter.

Author

N63-14484 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

METEOROLOGICAL DATA REPORT. NIKE-APACHE SR-006

Gordon L. Dunaway Mar. 1963 29 p 1 ref
(ERDA-8)

Meteorological data gathered for the launching of Nike-Apache SR-006 are presented for the U.S. Army Electronics Research and Development Activity and for ballistic studies. The data are presented along with calculated ballistic data.

Author

N63-14523 New York U. Coll. of Engineering, N.Y.

PROBABILISTIC DYNAMICS Final Report (and Accompanying Documents)

Max A. Woodbury June 30, 1962 48 p 8 refs
(Contract AF 19(604)-4981)
(AFCRL-62-1114)

CONTENTS:

1. PROBABILISTIC DYNAMICS. ESTIMATION THEORY FOR FUNCTIONS OF SPECTRAL DENSITY Interim Technical Report No. 1 Max A. Woodbury and Isidor Pomper p 10-20 (See N63-14524 10-21)
2. PROBABILISTIC DYNAMICS Final Report Max A. Woodbury p 21-28 (See N63-14525 10-12)

N63-14524 New York U. Coll. of Engineering, N. Y.

PROBABILISTIC DYNAMICS. ESTIMATION THEORY FOR FUNCTIONS OF SPECTRAL DENSITY Interim Technical Report No. 1

Max A. Woodbury and Isidor Pomper Aug. 1960 *In its* Probabilistic Dynamics Final Report June 1962 p 10-20 1 ref
(See N63-14523 10-21)

An attempt is made to combine statistical and dynamic weather forecasting techniques so as to be able to obtain a measure of the uncertainty of the atmosphere's present state and also the growth of such uncertainty with the passage of time in the absence of additional observations. A one-dimensional stochastic, linearized baratropic model of the atmosphere was used as the basis for this study. The behavior of the system is described by a partial differential equation which treats observations as the information which conditions the probability distribution of states of the atmosphere as further time information becomes available. Since the process involves a random solution which is jointly stationary over time and place, the spectral density is estimated from a time-space sample. Calculations are presented for the effect of the unknown parameters on the estimates of the spectral density functions, the determination of a best estimator, and the bias in the estimates.

M.P.G.

N63-14575 Air Weather Service, Scott AFB, Ill.
THE CLIMATOLOGICAL WIND AND WIND VARIABILITY BETWEEN 150,000 AND 200,000 FEET
Herbert S. Appleman Mar. 1963 8 p 4 refs
(AWS-TR-166)

The data used in this study came from the first eight volumes of the Meteorological Rocket Network Data Reports. The rocket soundings were made intermittently over the period October 1959 to August 1961. Stations used in this analysis were Cape Canaveral, Elgin Air Force Base, Point Mugu (including the Pacific Missile Range), White Sands (including Holloman Air Force Base), Wallops Island, Tonopah, and Kauai. In order to increase the size of the data sample, the reports from all stations were combined into zonal values representative of the southern half of the United States. Results of data analysis were: (1) The mean monthly and seasonal winds, together with their variability, were computed for the period and area studied. (2) The natural seasonal groupings were determined and found to be dominated by a surprisingly long winter season of strong westerlies and a shorter but more uniform summer period of strong easterlies, separated by brief transitional seasons of weak and variable winds. The seasonal shifts occur first at the highest level, then proceed downward over a period of about ten days. Both the winter and summer wind speeds increase strongly with altitude over the altitude range studied. The wind variability is found to be much greater in winter than in summer, and somewhat greater at the two higher levels than at 150,000 feet. However, the relative variability, based on the average wind speed for the sample, decreases with altitude. Similarly, the relative variability is least in summer and greatest in the transitional seasons. I.v.L.

N63-14586 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A RADIATION VIEW OF HURRICANE ANNA FORM THE TIROS III METEOROLOGICAL SATELLITE
W. R. Bandeen, B. J. Conrath, W. Nordberg, and H. P. Thompson Washington, NASA, Apr. 1963 18 p 7 refs Presented at the Intern. Symp. on Rocket and Satellite Meteorology, Washington, Apr. 23-25, 1962
(NASA TN D-1713) OTS: $0.50

The Tiros III meteorological satellite, containing two television cameras and a family of electromagnetic radiation experiments, was launched on July 12, 1961. Nine days later, the satellite passed directly over Hurricane Anna, the first hurricane of the 1961 Atlantic season. Data gathered by a five-channel medium resolution radiometer during one pass over the Hurricane are presented in the form of maps; and certain implications of the data are discussed. Supporting televison pictures are also given. The design and calibration of the medium resolution radiometer are briefly described. Author

N63-14654 California U., Berkeley
STOCHASTIC MODELS FOR THE INTERPRETATION OF METEOROLOGICAL DATA Final Report
F. N. David Jan. 1963 25 p
(Contract AF 19(604)-8051)
(AFCRL-63-241)

Stochastic models which lead to the observed serial and spatial correlations of winds, temperatures, pressures, precipitation, etc. are built and procedures for estimating the parameters of their mechanisms and for determining their significance are developed. A new approach to building the model, based on dynamic theory, is used, building tentatively and then correcting the errors during construction. Approximations are made and are seen to agree generally with observed data, but are not yet usable over a very wide range, for which predictions are necessary. D.E.R.

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-14274 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF THE EFFECT OF ALTIMETER-SYSTEM ACCURACY ON COLLISION PROBABILITY
William Gracey Washington, NASA, Mar. 1963 10 p 2 refs
(NASA TN D-1627) OTS: $0.50

The probability of collision between two airplanes has been determined for their normal assignment to adjacent flight levels and for their very rare misassignment to the same flight level. Collision probabilities were computed for a flight-level separation minimum of 500 feet, airplane vertical dimensions of 20 and 40 feet, altitude-misassignment probabilities of 1/100,000 and 1/1,000,000, and altimeter-system errors (3σ valers) ranging from 0 to 2,000 feet. The results of the analysis showed that minimum collision probabilities occurred at altimeter-system errors of about 200 feet, and that for altimeter-system errors from 500 to 2,000 feet, the collision probability was several orders of magnitude greater than that for altimeter-system errors of 250 feet or less. Author

N63-14444 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TWO SIGHTING PROBLEMS ASSOCIATED WITH SEXTANT TYPE MEASUREMENTS FOR SPACE NAVIGATION
Washington, NASA, Apr. 1963 9 p
(NASA TN D-1653) OTS: $0.50

CONTENTS:

1. THE EFFECT OF FIELD OF VIEW ON STAR FIELD IDENTIFICATION Daniel M. Hegarty p 2-3 (See N63-14445 10-22)
2. PRELIMINARY MEASUREMENTS OF THE ACCURACY OF MANUAL OPTICAL SIGHTING AT THE CENTER OF A PLANETARY DISK Marvin H. Thigpen p 5-6 (See N63-14446 10-22)

N63-14445 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECT OF FIELD OF VIEW ON STAR FIELD IDENTIFICATION
Daniel M. Hegarty *In its* Two Sighting Problems Associated with Sextant Type Measurements for Space Navigation Apr. 1963 p 2-3 (See N63-14444 10-22) OTS: $0.50

Tests were made to determine how the time required for a subject to identify a star field depends upon the field of view of the area to be identified. Preliminary results with subjects inexperienced in stellar recognition show that a most important factor in identification is the presence of an "easily recognizable" pattern which the subject can carry in his mind for comparison with the reference area. As the test area becomes larger, the chosen pattern becomes more complicated, and the orientation of the test area to the reference area becomes increasingly important as a factor in the time required for identification. These results are relevant to the use of remote TV for monitoring the pointing direction of a satellite and indicate the field of view required by the ground operator. M.P.G.

N63-14446 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY MEASUREMENTS OF THE ACCURACY OF MANUAL OPTICAL SIGHTING AT CENTER OF A PLANETARY DISK
Marvin H. Thigpen *In its* Two Sighting Problems Associated With Sextant Type Measurements for Space Navigation Apr. 1963 p 5-6 (See N63-14444 10-22) OTS: $0.50

The accuracy to which an observer can estimate the center of a planetary disk with a theodolite was measured. The effects of theodolite reticle design, the shape of the visible portion of the disk (elliptical or crescent), and the motion of the target planet and the observer were considered. The results indicate that: (1) when the observer and target are stationary, the design of the theodolite is the factor affecting precision; (2) motion of the observer does not contribute any error; and (3) when the target is moving, the precision deterioriates with increasing target speed. Since apparent target size and apparent target speed are a function of the power of the optics used, any extrapolation of this data to cislunar problems must include the power of the optics contemplated. M.P.G.

N63-14715 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GUIDANCE OF SPACE VEHICLES
John R. Savill Repr. from Navigation, v. 8, no. 1, 1961 p 24-33 Presented at the Calif. Inst. of Tech. Western Regional Meeting, Pasadena, Jan. 28, [1961]

The guidance of lunar and planetary spacecraft is investigated with emphasis on tradeoffs between injection, midcourse, and terminal guidance and also on the ways of mechanizing them with radio, inertial, or celestial techniques. It appears from the investigations that for deep space, lunar, and planetary applications inertial guidance is the best; midcourse maneuvers can be carried out optimumly with a ground command radio guidance; and terminal guidance normally will call for some form of self-contained radio or optical measurements. A.R.B.

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 24 Physics, Solid-State.

N63-14232 CryoVac, Inc., Columbus, Ohio
THEORETICAL STUDY OF LARGE CAPACITY REFRIGERATION SYSTEMS FOR 88° K AND 20° K LOADS Technical Documentary Report [May 7, 1962-February 7, 1963]
C. B. Hood, Jr., W. W. Vogelhuber, and R. F. Barron Arnold Engineering Development Center, Mar. 1963 109 p
(Contract AF 40(600)-988)
(AEDC-TDR-63-71)

A comparison of the theoretical performance of several thermodynamic cycles which could be utilized in systems providing refrigeration effect at 20° K (36° R) and 88° K (-300° F) was made. A single expander helium cycle with liquid-nitrogen precooler was selected for the 36° R load and an open, split-stream cycle utilizing nitrogen as the refrigerant was selected for the -300° F load. A detailed thermodynamic analysis was conducted of both cycles, and the operating state points and expected system performance were determined. Operation and control of systems incorporating these cycles were investigated as applied to cryopumping and nitrogen reliquefaction in a large space-simulation facility. The cost of the refrigeration capability was estimated utilizing modular units to provide a total capacity of 200 kw at 36° R and 6000 kw at -300° F. Author

N63-14233 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.
ROTATIONAL EXCITATION AND MOMENTUM TRANSFER CROSS SECTIONS FOR ELECTRONS IN H_2 AND N_2 FROM TRANSPORT COEFFICIENTS
L. S. Frost and A. V. Phelps Feb. 19, 1962 50 p 45 refs
(Partially supported by ARPA and AF Special Weapons Center)
(Sci. Paper 62-908-113-P1)

Rotational excitation and momentum transfer cross sections for low-energy electrons in hydrogen and nitrogen are obtained from a comparison of theoretical and experimental values for the mobility and the diffusion coefficients. The theoretical values of the transport coefficients were obtained by calculating accurate electron-energy-distribution functions using an assumed set of elastic and inelastic cross sections. The discrete nature of the energy loss occurring in a rotational or vibrational excitation collision was included in the theory, as were collisions of the second kind with thermally excited molecules. The resulting values of drift velocity and characteristic energy, D/μ, were compared with experimental data and adjustments made in the assumed cross sections until good agreement was obtained. The momentum transfer cross sections found in this manner agree well with several recent analyses valid in restricted energy ranges. The final values of the rotational excitation cross sections in H_2 are 1.7 times the values computed using the theory of Gerjuoy and Stein and the latest available values for the molecular electric quadrupole moments. In hydrogen, the analysis has been extended to energies for which vibrational excitation is important. A vibrational cross section with a maximum of roughly 5×10^{-17} cm^2 at 3 ev is consistent with the measurements. Author

N63-14235 Brandeis U., Waltham, Mass.
PROPERTIES OF VERTEX FUNCTIONS IN STRONG INTERACTIONS
Sudesh Bose (Ph. D. Thesis) Jan. 1963 81 p 13 refs

Analytic properties of some vertex functions of strongly interacting particles are studied in order to obtain relations between the masses and the coupling constants. A study is made of $\Sigma\Lambda\Pi$ vertex for even $\Sigma\Lambda$ relative parity. A relationship between the masses of Σ, Λ, and Π and the $\Sigma\Lambda\Pi$ coupling constant is obtained. The same techniques are applied to the vertices of $\Sigma\bar{K}N$ and $\Lambda\bar{K}N$. The value of the ratio of $\Lambda\bar{K}N$ and $\Sigma\bar{K}N$ coupling constants is obtained. A calculation is made of the isovector charge form factor of Σ-particle. Only the two pion intermediate states are retained and the amplitude $\Pi+\Pi\rightarrow\Sigma+\bar{\Sigma}$ is approximated by a Λ-pole. By writing down an unsubtracted dispersion relation for the charge form factor for zero momentum transfer, and by invoking the requirement of normalization at zero momentum transfer, another independent relation between the masses of Σ, Λ, and Π and the $\Sigma\Lambda\Pi$ coupling constant is obtained. The values of the $\Sigma\Lambda\Pi$ coupling constant and Σ-mass are then calculated. The electromagnetic form factor of Σ is calculated by a technique suggested by Cutkosky. The value of anomalous magnetic moment of Σ is obtained. Author

N63-14237 Purdue U., Lafayette, Ind.
TABLES OF DIRECTIONAL CORRELATION ATTENUATION COEFFICIENTS FOR COMBINED MAGNETIC DIPOLE RANDOMLY ORIENTED ELECTRIC QUADRUPOLE INTERACTIONS. PART 1 - SPIN OF INTERMEDIATE NUCLEAR STATE I = 1 AND I = 2
E. Matthias, W. Schneider (Uppsala U.), and R. M. Steffen AEC

Div. of Tech. Inform., Oct. 1962 239 p 9 refs For Part II see N63-14285 10-23
(Contract AT(11-1)-123)
(TID-17089(Pt. I)) OTS: $3.00

Tables are presented which give the results of numerical computer calculations, based on the theory of Alder, Matthias, Schneider, and Steffen, on static combined magnetic and electric perturbation. A.R.B.

N63-14240 Arkansas U., Fayetteville
SPECTROSCOPIC STUDIES WITH ION BEAMS **Technical Report**
R. H. Hughes, J. L. Philpot, J. G. Dodd, and S. Lin Sept. 1962 48 p 21 refs
(Contract AF 19(604)-4966)
(AFCRL-63-225)

A spectroscopic study of ion-atom and ion-molecule collision processes has been undertaken. Absolute cross sections for excitation of principal visible features are presented in this report for proton impact on He, H_2, and N_2 in the proton-energy range from about 10 Kev to 130 Kev. Optical radiation is observed at an angle to the beam, which allows measurement of charge-changing cross sections for electron capture into certain excited states of hydrogen. Reprints of published studies of 200-Kev proton impact on He and N_2 are included together with a reprint of a note describing some spectral features of 200 Kev H_3^+, and 130 to 200 Kev H_2^+ impact on H_2 and He. Included also are calculated minimum-energy defects for several reactions. Author

N63-14242 Iowa State U. of Science and Tech., Ames
INJECTION OF ELECTRONS INTO ANNULAR MACHINES, II. DISCUSSION OF EXPERIMENTAL RESULTS
Luigi Gonella AEC Div. of Tech. Inform., Oct. 1962 85 p 6 refs
(Contract W-7405-eng-82)
(IS-522) OTS: $2.00

The influence on the intensity of the injection-voltage rate of rise was investigated in a conventional 70-mev electron synchrotron, injected at about 50 kv with suitable trapezoidal pulses. The intensity depends in the usual way on the various parameters, but is independent of the pulse-front slope in any condition of the machine, with the injection voltage and current varying by a factor 2. The intensity, however, is maximum at the apex of the pulse, and its variation with the pulse phase shows that matching the acceptance region cannot be critical: the capture is stopped before the time available for the injection is fully utilized. The possible saturation of the donut was tested by simultaneously injecting with two guns (which had different yields). The two injected beams never add to each other (rather, one of them may kill the other) thus showing that the donut is saturated. The more efficient gun takes over the injection completely when near its optimum phase, and disturbs the injection from the other one, reducing the total yield to a very low value, when out of phase or at lower voltage. The general terms of the injection problem are analyzed for allowing a better discussion of the experiments. The discussion shows that the saturation cannot be ascribed to a space-charge limitation of the circulating current; instead, the Central Shift Capture Mechanism, as developed in the first part of the report, may explain the stong interaction between different injected beams and the dependence of the intensity on the injection current and the other parameters even while the donut is saturated. Author

N63-14259 Catholic U. of America. Stress Analysis Lab., Washington, D.C.
RECENT ADVANCES IN THE APPLICATION OF PHOTOELASTICITY IN THE MISSILE INDUSTRY **Interim Report No. 3**
A. J. Durelli Oct. 1962 30 p 33 refs
(Contract Nonr-2249(06))

This paper deals with several applications of photoelasticity to the stress analysis of rocket-propellant grains. The applications include two- and three-dimensional model analyses, and they refer to grains loaded by pressure and by temperature. The paper also includes some applications to the optimization of fillet contours and to the redesign of case joints. Author

N63-14264 Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Oct. 1962 43 p refs
OTS: $1.25

CONTENTS:
1. A RADIAC CALIBRATOR FOR SHIPBOARD USE S. G. Gorbics and A. E. Nash p 1-7 3 refs (See N63-14265 10-15)
2. RELATIVE THERMAL CONDUCTIVITY AND EXPANSION CHARACTERISTICS OF SEVEN TRANSDUCER MATERIALS K. G. Skinner p 8-12 1 ref (See N63-14266 10-18)

N63-14269 Watertown Arsenal. Materials Research Lab., Mass.
A THEORETICAL INVESTIGATION OF SOME MAGNETIC AND SPECTROSCOPIC PROPERTIES OF RARE-EARTH IONS
R. E. Watson (AERE, Harwell, Eng.) and A. J. Freeman May 1962 60 p 87 refs
(Partially supported by Nat. Sci. Found.)
(MRL-118)

Investigations of some magnetic and spectroscopic properties of rare-earth ions based on approximate Hartree-Fock calculations are reported. First, a set of conventional, nonrelativistic Hartree-Fock wave functions were obtained for Ce^{3+}, Pr^{3+}, Nd^{3+}, Sm^{3+}, Eu^{2+}, Gd^{3+}, Dy^{3+}, Er^{3+}, and Yb^{3+}; second, calculations for Ce^{3+} were carried out in which spin-orbit coupling was directly included in the conventional Hartree-Fock equations in order to obtain some estimate of wave function dependence on J and the resulting effects on experimental quantities. These results are then used to discuss spin-orbit splittings, hyperfine interactions and the determination of nuclear magnetic moments, the Slater $F^k(4f,4f)$ integrals, and the crystal-field parameters, $V_n^m = A_n^m \langle r^n \rangle$, all of which depend fairly critically on the precise form of the 4f wave functions. Comparisons are made with experiment and with the results of previous theoretical investigations which relied on either Hartree or modified hydrogenic wave functions or on semi-empirical parametrizations. Author

N63-14272 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTICAL PROPERTIES OF SATELLITE MATERIALS—THE THEORY OF OPTICAL AND INFRARED PROPERTIES OF METALS
Washington, NASA, Mar. 1963 252 p 84 refs
(NASA TN D-1523) OTS: $4.00

The probable effects of solar radiation, primary cosmic rays, Van Allen radiation, and meteoric dust on the emissive properties of materials are reviewed in the light of recently published data. Experimental data on the spectral emittance (0.25 to 27 microns) of metals with polished and carefully abraded surfaces are presented. A quantum mechanical theory of optical and infrared dispersion in metals originally developed by T. Holstein and previously presented in unpublished Westinghouse Research Laboratories Research Reports 60-94698-3-R1 and 60-94698-3-R6 (1954 and 1955) is combined with other existing theories of Umklapp and impurity scattering processes and is shown to successfully account for the optical properties of metals in the entire free electron region at all temperatures of interest. Detailed calculations are presented for monovalent and some polyvalent metals for which assumption of a symmetric Fermi surface is valid. Polyvalent and transition metals for which interband transitions are important and the Fermi surface is not spherical are also considered. In all, more than a dozen metals, for which reliable experimental data are available, have been successfully treated. Calculations of the absorption properties of superconducting metals are also presented in an attempt to determine the extent to which bulk electron-phonon processes are responsible for infrared absorption by superconductors. Author

N63-14275 Yale U., New Haven, Conn.

ALKALI POLARIZABILITIES BY THE ATOMIC BEAM ELECTROSTATIC DEFLECTION METHOD

George E. Chamberlain and Jens C. Zorn Repr. from Phys. Rev., v. 129, no. 2, Jan. 15, 1963 p 677-680 13 refs

(NASA Grant NsG-1-59)

The electric dipole polarizabilities of the alkali atoms have been measured by observing the deflection of a collimated beam of neutral atoms in a two-wire-type inhomogeneous electric field. Beam deflection measurements are taken both for the case when s_B, the deflection of atoms with the most probable velocity in the source, is larger than the detector wire width w_d, and for $s_B < 0.1 w_d$. The results in units of 10^{-24} cm^3 are: $\alpha(Li) = 22 \pm 2$, $\alpha(Na) = 21.5 \pm 2$, $\alpha(K) = 38 \pm 4$, $\alpha(Rb) = 38 \pm 4$, and $\alpha(Cs) = 48 \pm 6$. These values are in reasonable agreement with other recent experimental and theoretical determinations of the alkali polarizabilities. Author

N63-14280 Battelle Memorial Inst., Columbus, Ohio

EXPERIMENTS ON ENHANCED CATALYTIC ACTIVITY FROM INTERNAL IRRADIATION OF CATALYSTS

James L. Mc Farling and John F. Kircher Feb. 28, 1963 21 p 18 refs

(Contract W-7405-eng-92)

(BMI-1620) OTS: $0.50

An experimental study of the effect of internal fission-product beta radiation on a cyclohexanol dehydration catalyst was performed. The catalyst used was a $CaCl_2$-35 w/o $MgSO_4$ mixture to which was added about 5 w/o ceramic-coated UO_2 fuel particles. Conversion efficiency of this catalyst, with and without the fuel particles, was compared before neutron irradiation and after irradiation at three neutron-dose levels. The experimental results indicated that little, if any, change occurred in the efficiency of the catalyst in contrast to previously reported work with a similar catalyst mixture containing Ca^{45}. Author

N63-14285 Purdue U., Lafayette, Ind.

TABLES OF DIRECTIONAL CORRELATION ATTENUATION COEFFICIENTS FOR COMBINED MAGNETIC DIPOLE AND RANDOMLY ORIENTED ELECTRIC QUADRUPOLE INTERACTIONS. PART II—SPIN OF INTERMEDIATE NUCLEAR STATE I=3/2 AND I=5/2

E. Matthias, W. Schneider (Uppsala U.), and R. M. Steffen AEC Div. of Tech. Inform., Oct. 1962 241 p 9 refs For Part I see N63-14237 10-23

(Contract AT(11-1)-123)

(TID-17089(Pt. II)) OTS: $3.00

A list of tables giving the results of numerical computer calculations based on the magnetic and electric perturbation theory of Alder, Matthias, Schneider, and Steffen is presented. The attenuation coefficients which allow the computation of the perturbed directional correlation functions in a straightforward manner are tabulated as functions of various interaction parameters. The general angular correlations of emitted radiations and the influence of extranuclear fields are discussed briefly. Normalized spherical harmonics and ordinary legendre polynomials are given in tabular form. D.E.R.

N63-14289 Rice U., Houston, Tex.

LOW TEMPERATURE INTERNAL FRICTION IN GOLD AND COPPER

S. Okuda [1962] 22 p 12 refs Submitted for Publication

(NASA Grant NsG-6-59)

OTS: $2.60 ph, $0.86 mf

An inverted torsion pendulum apparatus is described for the measurement of internal friction and dynamic modulus of metals over the temperature range 4° to 300° K after deformation *in situ* at 4° K. A detailed study of low-temperature internal friction peaks in pure gold and copper was carried out using this apparatus. By comparison of the present results with other measurements, reported in the literature, the activation energies for the Niblett-Wilks peak ($E_{N.W}$) and for the Bordoni peak (E_B) in gold and copper were deduced. The internal friction below 15° K was found to rise for gold specimens deformed at low temperature. This rise is discussed in detail and may suggest the existence of a relaxation peak below 15° K in cold-worked gold. Author

N63-14308 Hanford Atomic Products Operation, Richland, Wash.

RADIOISOTOPIC HEAT SOURCES

C. A. Rohrmann Feb. 1, 1963 54 p 26 refs

(Contract AT(45-1)-1350)

(HW-76323) OTS: $1.25

The properties of those radioisotopes that are considered useful as heat sources are reviewed in this article, along with their feasibility, characteristics, and method of production and use. Data are provided which justify their consideration for use as heat sources. Special emphasis is placed on discussing the two radioisotopes now in use as heat sources: strontium-90 and plutonium-238. D.E.R.

N63-14325 Rochester U., N.Y.

THREE PHOTON DECAY OF POSITRONIUM ^1S STATE AS A TEST OF CHARGE CONJUGATION INVARIANCE

Joseph Schechter Feb. 18, 1963 16 p 4 refs Submitted for Publication

(Contract AT(30-1)-875)

(NYO-10259)

To make comparisons with a possible experiment to test charge conjugation invariance, the angular distribution of decay photons is estimated for the forbidden 3γ decay of the ^1S state of positronium using the simplest matrix element satisfying Lorentz, gage, and TCP (T is the time-inversion operation, C, the charge conjugation operation, and P, the purity operation) invariance. Author

N63-14326 Rochester U., N.Y.

ON THE RELATIVE WEIGHTS OF THE DECAYS OF CERTAIN RESONANCES IN THEORIES WITH BROKEN SYMMETRY

C. Dullemond (Washington U., Seattle), A. J. Mac Farlane, and E. C. G. Sudarshan Mar. 4, 1963 11 p 9 refs Submitted for Publication

(Contract AT(30-1)-875)

(NYO-10260)

The derivation of relationships that exist among the relative weights of the decays of various resonances into baryon-meson states in the Neeman-Gell-Mann theory of strong interactions is attempted. Particularly, the paper deals with those resonances with the irreducible representation of SU_3 with highest weight. The consequences of charge independence and invariance under the Weyl reflections of SU_3 are used to derive the full solution of the zeroth-order problem, but the first-order problem is not fully solved. The methods of each system discussed are adaptable to scattering and production reactions. D.E.R.

N63-14329 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

REACTION OF HYDROGEN AND OXYGEN IN SILENT ELECTRICAL DISCHARGE VI. KINETIC ANALYSIS OF THE PROCESS USING THE EQUATIONS OF IRREVERSIBLE FIRST-ORDER PARALLEL-CONSECUTIVE REACTIONS

I. A. Semiokhin, N. I. Kobozev, and Ye. N. Pitskhelauri Sept. 17, 1962 18 p 3 refs Transl. from Zhur. Fiz. Khim. (Moscow), v. 36, 1962 p 336-344

(FTD-TT-62-1171/1+2+4)

The kinetics of the processes of the reaction between oxygen and hydrogen in glass-metal reactors were studied quantitatively to determine whether they conform to the scheme of first-order parallel-consecutive irreversible reactions. It was found that conformity did occur. A.R.B.

N63-14337 Laboratoire de Physique Théorique et Hautes Énergies, Orsay (France)

K* GENERATION BY ρ-EXCHANGE

B. Diu, J. L. Gervais, and H. R. Rubinstein Mar. 1963 14 p 8 refs
(Supported by Columbia U.)

The K* problem is analyzed as a nuclear resonance in which the rho meson plays the key role as the binding force in the sense that Chew and Frautschi have described. Qualitative results are given for both the $T = \frac{1}{2}$ state where K* is not a self-sustained particle and for the $T = \frac{3}{2}$, $J = 1$ state, where the rho contribution is repulsive and the K* contribution is attractive. The simple model of the K* resonance gives the following results: (1) the relative sign of f_K and f_{pi} has to be negative in order that a solution exist; (2) taking the experimental width, one finds a good mass of 750 Mev; $3.f_{pi}\ f_K\ /\ 4$ pi comes out too large. These results should not be changed too much by adding the K* force to the rho force and there is hope that a 2-channel solution will give interesting answers. D.E.R.

N63-14339 Johns Hopkins U. Carlyle Barton Lab., Baltimore, Md.

CROSS RELAXATION IN NON-ZEEMAN SPIN SYSTEMS Technical Report

Jan M. Minkowski Feb. 1963 180 p 36 refs
(Contract AF 33(616)-6753)
(AF-101)

The theory of cross relaxation in diluted spin systems is investigated. To subject the theory to a quantitative comparison with the results of the experimental study of a non-Zeeman spin system, previous techniques of computing the moments of the line shapes are modified. This new method gives the 2n-th moment of cross-relaxation lines as a polynomial of the n-th order in the concentration f of the paramagnetic ions. The order of the polynomial in f is shown to be independent of the order of the cross-relaxation process. The leading term in all of the moments is concentration independent and it can be determined with much less labor by the technique presented below than by any of the earlier methods. The new technique is applied to show that the moments of the line shape of paramagnetic lines are also polynomials in f, but the concentration independent terms are missing. The reasons underlying this difference in f-dependence of the paramagnetic and cross-relaxation line shapes are discussed.

Author

N63-14342 Atomics International, Canoga Park, Calif.

REFLECTED REACTOR KINETICS

R. W. Keaten and C. W. Griffin Mar. 1, 1963 23 p 7 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7263) OTS: $0.50

The transfer function of a reflected reactor has been derived from a model which is applicable to all reactors. The result is identical to a bare reactor transfer function at low frequencies, provided that the neutron lifetime includes the effect of the reflector. At high frequencies the reflector introduces in effect an additional group of delayed neutrons. A calculation of the effective neutron lifetime in the Sodium Reactor Experiment (SRE) from the theoretical results was in good agreement with the experimental value. Author

N63-14361 Carnegie Inst. of Tech., Pittsburgh, Pa.

SOLID SURFACE MORPHOLOGIES GOVERNED BY CAPILLARITY [Technical Report]

W. W. Mullins [1962] 88 p 49 refs
(Grant DA-ORD-31-124-61-G11)
(AROD-2781-3)

The theoretical principles are reviewed that regulate the morphologies assumed by solid surfaces which are in equilibrium, or which are approaching equilibrium, under the action of capillary forces (e.g. surface tension). Included are: the definition of surface tension and its thermodynamic relationships; a definition of surface stress and its relation to surface tension; a discussion of anisotropy in crystals; equilibrium problems of capillary theory; curvature effect on the chemical potential of surface atoms; and description of kinetic changes in surface morphology occurring by capillarity-induced transport of material. D.E.R.

N63-14368 Little (Arthur D.) Inc., Cambridge, Mass.

RESULTS OF SUPERCONDUCTING MAGNET SURVEY

Apr. 30, 1962 16 p

Information, resulting from a survey, on the practical aspects of superconducting magnets in laboratory research is tabulated. Quantitative information was obtained concerning: (1) type of present research using conventional medium or high-field electromagnets; (2) how soon researchers plan to use superconducting magnets after they become commercially available; (3) proposed applications for superconducting magnets; and (4) general size and performance parameters desired. A 70% response (1297 replies) to the survey was obtained from persons known to be interested in superconducting magnets. Of these, roughly half were currently using electromagnets in their research and half were not. Half would be interested in using superconducting magnets, 25% as soon as possible, and 25% in an estimated two years or more. The size and performance parameters desired were related to the proposed applications, which included solid-state physics, low-temperature physics, nuclear physics, and plasma physics and magnetohydrodynamics. M.P.G.

N63-14372 California U., Los Angeles

SPIN WAVES AND NUCLEAR MAGNETIC RESONANCE ENHANCEMENT IN NiF_2 DOMAIN WALLS Technical Report No. 5

David I. Paul Mar. 2, 1963 20 p 9 refs
(Contract Nonr-233(63))

The allowed magnetic resonance modes or spin waves in the canted antiferromagnet NiF_2, in the presence of a Bloch Wall, were obtained. The formulation of the problem included the anisotropy and exchange energies of the crystal, together with such wall characteristics as stiffness, mass, and viscosity. The dispersion relations showed the existence of a bound wall excitation branch having a lower excitation energy than the free wave excitation branch. Results of the calculation of the effective nuclear magnetic resonance field enhancement due to the bound wall excitation branch as a function of the parameters of the crystal and the Bloch wall were equivalent to those obtained experimentally. A comparison of this enhancement with that of a pure antiferromagnet demonstrated that the canting is essential for this process. I.v.L.

N63-14374 Rochester U. Inst. of Optics, N.Y.

OPTICAL PROPERTIES OF "LIUMOGEN": A PHOSPHOR FOR WAVELENGTH CONVERSION Technical Note No. 4

N. Kristianpoller and David Dutton Mar. 1963 31 p 12 refs
Submitted for Publication
(NASA Contract NASw-107)
OTS: $3.60 ph, $1.13 mf

Optical and physical properties of the phosphor 2,2'dihydroxy 1,1'napthaldiazine ("liumogen") have been investigated. Emission, absorption, and excitation spectra have been measured, as well as dependence of the emission upon the excitation wavelength and the temperature. Methods of sample preparation have been tested. The compound appears to have some notable advantages as a wavelength conversion detector. The material may be sublimed in vacuum without decomposition, and thus may be used in the form of thin transparent films. These films show a reasonable stability. The absorption edge occurs at ~4600A; the main emission is in the yellow-green spectral region. The luminescence quantum yield of the phosphor is nearly independent of the excitation wavelength from 4600A to at least 900A. The efficiency increases by a factor of ~2.5 upon cooling to 80° K. Author

N63-14395 University of Southern Calif. Engineering Center, Los Angeles

ELASTIC SCATTERING OF NEUTRAL MASS-POINT PARTICLES BY A TWO-DIMENSIONAL PERFECT CRYSTAL [Summary Report]

Earl Beder *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 95-101 refs (See N63-14379 10-11)

The elastic scattering of neutral mass-point particles by a two-dimensional semi-infinite dielectric crystal has been studied to determine what effect low-energy elastic collisions might have on surface forces in rarefied gasdynamics. Van der Waal's physical adsorption forces represent the gas-solid interaction potential, and a small periodic perturbation potential accounts for the greater part of the scattering. The scattering problem is solved classically and quantum mechanically, and the classical theory is found to be unrealistic in detail. The quantum mechanical theory, though, is found to be restrictive. Therefore, further study is necessary for evaluation of the theories. D.E.R.

N63-14396 University of Southern Calif. Engineering Center, Los Angeles

IMPROVEMENT OF CRYOPUMP [Summary Report]

J. G. Everton *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 102-107 refs (See N63-14379 10-11)

The initial design of the cryopump for the USC low-density wind tunnel is described. Its shortcomings and limitations are enumerated. Modifications have been effected to circumvent the limitations and to eliminate the shortcomings as much as possible, e.g., by increasing the valve opening area and by replacing the dry radiation shields with liquid-nitrogen cooled shields. The new arrangement is described, and diagrams of the pump and its capabilities are included. Then the modified pump's effectiveness, in terms of its effective refrigeration, is calculated, and pump operation is described. D.E.R.

N63-14398 Texas U. Defense Research Lab., Austin

GUIDE TO THE SELECTION OF ACOUSTIC FILTERS FOR LIQUID-FILLED SYSTEMS

E. L. Hixson, J. V. Kahlbau, and D. G. Galloway Sept. 1962 322 p 46 refs

(Contract NObs-86165)

(DRL-A-202)

This manual gives design methods and presents a summary of experimental test data for four basic types of passive, dissipationless acoustic filters for attenuating noise in liquid piping. Filters of the (1) side branch, (2) expansion chamber, (3) combination, and (4) Quincke tube types are considered. Analytical methods applicable to lumped parameter acoustical systems, transmission lines, and combinations of these are developed. Several different filter performance criteria are defined. One of these, transmission loss, is adopted for comparing filters independently of source and load characteristics. Author

N63-14415 Services Electronics Research Lab., Baldock (Gt. Brit.)

A 35 kMc/s STUB-SUPPORTED RING AND BAR TRAVELLING WAVE TUBE

J. F. Gittins and F. E. Wray *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 1-10 11 refs Submitted for Publication (See N63-14414 10-01)

This amplifier has a power output of 10 watts, a gain of 25 db, and a fixed voltage bandwidth of 300 mc/s. By varying the voltage from 6 to 11 kv, the tube can be operated over a frequency range from 35.5 to 34.0 kmc/s. Author

N63-14417 Services Electronics Research Lab., Baldock (Gt. Brit.)

SOME EXPERIMENTS ON THE EFFECT OF A CIRCUIT SEVER ON HIGH POWER TRAVELLING WAVE TUBE EFFICIENCY

M. O. Bryant *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 21-25 4 refs Presented at the Fourth Intern. Cong. on Microwave Valves, The Hague, Sept. 1962 (See N63-14414 10-01)

This paper describes experiments on 5 kw c.w. tubes for the 3-cm band whose severs were matched into loads outside the vacuum envelope, thus allowing a comparison of the efficiency of each tube with that of its output section alone. Because the tubes could be operated over a 1.6:1 range of beam voltage, measurements were made at several different space-charge densities for each tube. It was found that the loss of efficiency caused by the sever has a marked dependence on the length of the sever tunnel as a function of the beam space-charge wavelength, as well as on the output section gain. If the sever is made sufficiently short, of the order of 0.02 λ_q or less, reasonable efficiency may be obtainable without using an excessively high gain-output section. Author

N63-14420 Services Electronics Research Lab., Baldock (Gt. Brit.)

SECONDARY ELECTRON EMISSION FROM A CLEAN TUNGSTEN SURFACE BOMBARDED BY VARIOUS POSITIVE IONS

L. N. Large *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 35-38 8 refs Submitted for Publication (See N63-14414 10-01)

The secondary electron coefficient, γ, has been measured for singly charged hydrogen, helium, nitrogen, neon, oxygen, argon, and krypton ions in the energy range 10 to 140 kev incident on a tungsten surface. Measurements have been made within the monolayer adsorption time (~5 mins.) after production of an atomically clean surface. In this energy range, γ increases with incident ion energy for all ions with the exception of protons where a maximum is reached at around 110 Kev. At constant energy, the yield is progressively higher as the ion mass is increased up to that for oxygen. For neon, argon, and krypton the yield at a constant energy is, however, less than that for oxygen. At a constant ion velocity, γ for atomic ions increases as the mass of the incident ion increases. Also, the rate of change of γ with ion velocity for these ions increases with increasing ion mass. The yield for H_2^+, N_2^+, and O_2^+ ions is approximately twice that for the corresponding atomic ions at the same velocity. Author

N63-14430 National Aeronautics and Space Administration, Washington, D.C.

SOME EFFECTS OF SPECTRAL CONTENT AND DURATION OF PERCEIVED NOISE LEVEL

Karl D. Kryter and Karl S. Pearsons (Bolt, Beranek, and Newman, Inc.) Apr. 1963 55 p 15 refs

(NASA Contract NASr-58)

(NASA TN D-1873) OTS: $1.50

A number of experiments were conducted in which listeners equated a wide variety of sounds with respect to noisiness (equal acceptability) and loudness. The principal findings are as follows: (1) On the basis of data obtained from approximately 250 subjects, new equal noisiness contours and tables for use in the calculation of perceived noise level were determined. (2) Over a range of durations from 1½ to 12 secs, sounds were judged equally acceptable when the sound pressure level was reduced by 4½ dB for each doubling of duration. Variations in rise and decay times from ½ to 4 secs did not significantly influence the judgments. (3) Combining a pure tone of sufficient intensity with a band of filtered white noise caused subjects to judge the sound as noisier than the same band of noise at the same overall sound pressure level as the tone-plus-noise. On the other hand, the judged loudness of the band of noise, keeping overall level constant, was not appreciably affected by the addition of the tone. (4) Calculated measures of perceived noise level (PNdb), loudness, and the readings on A, B, C, and "flat" scales on a sound level meter were determined for a variety of "real" and artificial sounds of equal duration when these sounds were judged to be equally noisy or acceptable. Considering both absolute values and variability in the results, the order of merit, from best to worst, of the various measures

for predicting the judgment data was as follows: PNdb, phons Zwicker, phons Stevens, "flat," C, B, and A scale of a sound level meter. Author

N63-14441 Naval Research Lab., Washington, D.C.
STATUS REPORT ON THERMOELECTRICITY, PART II—DEVICES [Ninth Quarterly Review, Part 2]
B. B. Rosenbaum (BuShips), J. W. Davisson, and Joseph Pasternak Jan. 1963 163 p refs
(NRL-Memo-1361)

The status of thermoelectric devices, including hardware and feasibility for various applications, is reported. The devices include: a silent system for food storage refrigeration on SSN 593 submarines; a prototype, thermoelectric, refrigeration system for submarines; thermoelectric air-conditioning systems for submarines; a cesium-137 powered 5-watt thermoelectric generator for deep-sea applications; UO_2 (or UZr)-PbTe thermoelectric, direct-conversion nuclear reactors; a 3MW(e) nuclear thermoelectric powerplant for unattended deep submergence operation; an external 500-kw thermoelectric generator having a pressurized water reactor heat source; rigid thermoelectric panels for a 5-kw generator; two thermoelectric generators for "back-pack" carry; solar thermoelectric panels; and methods of thermo-electrically cooling semiconductor components. M.P.G.

N63-14452 Louisiana State U. and Agricultural and Mechanical Coll., Baton Rouge
HALL EFFECT IN BISMUTH AND LIQUID HELIUM STUDIES Final Report, Feb. 1, 1961-Jan. 31, 1963
J. M. Reynolds [1963] 6 p 8 refs
(Grant DA-ORD-31-124-61-G76)
(AROD-1579-11)

The electron transport phenomena in zinc and bismuth single crystals at liquid helium temperatures were studied. In magnetic fields up to 14 kG., the electrical and thermal resistances, the thermoelectric power, the Hall, Righi-Leduc, Peltier, Ettinghausen, and Ettinghausen-Nernst effects were investigated. The kinetic coefficients were computed and curve fitting of conductivity coefficients to the Sondheimer-Wilson theory were made in terms of a four-band scheme. Theoretical computations and experimental observations were compared. D.E.R.

N63-14493 Oak Ridge National Lab., Tenn.
A FIFTEEN-YEAR SUMMARY OF PUBLICATIONS INVOLVING THE USES OF ELECTROMAGNETICALLY ENRICHED STABLE ISOTOPES
P. S. Baker Apr. 4, 1963 76 p 1358 refs
(Contract W-7405-eng-26)
(ORNL-3266) OTS: $2.00

A history of stable isotopes is given as a preface to a bibliography of their uses. The bibliography covers the following areas: moments and spins, decay studies, genetics, energy levels, cross sections and yields, agriculture, biology, geology, medicine, chemistry, and general physics. R.C.M.

N63-14499 Parke Mathematical Labs., Inc., Carlisle, Mass.
STUDY OF THE PROPERTIES OF MATTER USING DIFFERENTIAL GEOMETRIC METHODS Final Report
Jan. 1963 11 p 12 refs
(Contract AF 19(604)-7316)
(AFCRL-63-18)

The uses of geometry in theoretical physics and mathematical engineering were studied and correlated. A cursory survey of the literature showed three recognizable uses of geometry: (1) the use of space and space-time to describe physical configurations and events, (2) the equating of physics and geometry, and (3) geometrization of the analytical formulas of physics or engineering. Emphasis was placed on the third use (3) in exploring the importance of Lagrangian methods and Finsler space in the geometrization of a wide class of classical mechanical systems. A new Poincare epistomological sum that adds up to a geometrization of quantum mechanics was the result of these studies. The application of geometric methods to specific problems in electronic materials science included studies of zone melting purification, coherency in optics and quantum theory, electron straggling, and radiation damage to crystals. The conclusion is that geometrization and geometrical languages offer the best possibility of a common denominator for the collective use of ideas and results of interdisciplinary research. M.P.G.

N63-14500 California U., Berkeley. Inst. of Engineering Research
ON HEAT CONDUCTION IN ISOTROPIC ELASTIC SOLIDS
W. L. Wainwright Feb. 1963 6 p 1 ref
(Contract Nonr-222(69))
(Tech. Rept. 20; IER Ser. 131, Issue 20)

Research on heat conduction in isotropic elastic solids has led to a discussion of the constitutive equation for the heat flux vector where it is assumed that this vector is a function of the spatial components of the strainers and the temperature gradient. This equation is analyzed and the conclusion drawn in terms of the temperature gradient vector. D.E.R.

N63-14502 Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O AND Be-B-O SYSTEMS Quarterly Report No. 3, Dec. 1, 1962-Feb. 28, 1963
Paul E. Blackburn [1963] 7 p 10 refs
(ARPA Order 315-62)

The vapor pressures, thermodynamic properties, and phase diagrams of the Be-B-O and Al-B-O systems are being studied to evaluate propulsion systems. This study will present isothermal data over a wide range of condensed phase composition, whereas, in the past, only data over a very narrow range had been obtained. Measurements of the properties of Be_2O_3 have been made to test the equipment to be used in the study, since this is one of the principal species expected in this research. D.E.R.

N63-14519 Harvard U., Cambridge, Mass.
THE FERMI-CONTACT CONTRIBUTION TO THE PROTON-DEUTERON COUPLING CONSTANT IN HD
J. I. Musher [1962] 6 p 15 refs
(Supported by ONR and PHS)

The Fermi-contact contribution J_F to the indirect, scalar proton-deuteron coupling between the nuclear spins in the hydrogen deuterium molecule is calculated, using an approximate procedure for performing perturbation calculations on simple unperturbed wave functions. When the necessary integrals are evaluated, the calculated contribution to J_F from the one-electron terms is 3.0 cps while that from the two-electron term is -32.5 cps for a total of -29.5 cps. Arguments are presented that the negative sign of J_F is correct, although the approximation using an "average energy" denominator with a positive (and arbitrary) ΔE give J_{HD} as positive. M.P.G.

N63-14521 Sandia Corp., Albuquerque, N. Mex.
A STUDY OF GAMMA-RAY PHOTOCONDUCTIVITY IN ORGANIC DIELECTRIC MATERIALS
S.E. Harrison (M. S. Thesis–New Mexico U.) 1962 72 p 38 refs
(SCDC-2580)

The gamma-ray photoconductivities of polyethylene, polystyrene, polyvinylchloride, polypropylene, Teflon, nylon, Kel-F, and three thermosetting resins denoted as Epoxy 1478-1, 1478-3, and 1478-22 have been measured. The measurements were made at steady-state gamma-ray intensities ranging from 1.0 rad(H_2O)/min to 3.0 x 10^5 rads(H_2O)/min and at controlled temperatures ranging from 90° F to 140° F. Conductivity changes resulting from the steady-state gamma-ray exposures were measured continuously throughout the exposure

and after the exposure. The exposure period was of sufficient duration to allow all samples to achieve an equilibrium conductivity value. The conductivity was found to exhibit distinct features in three time intervals: interval 1 is where photoconductivity is responding to a step increase in radiation intensity; interval 2 is where the photoconductivity has reached an equilibrium value whose magnitude is defined by radiation intensity and temperature; and interval 3 is where the conductivity is recovering upon sample removal from the gamma-ray environment. Author

N63-14532 Denver Research Inst., Colo.

BASIC STUDIES ON RADIATION ENERGY TRANSFER MECHANISMS OF CHEMICAL SYSTEMS [Summary Report, June 1, 1961-Aug. 31, 1962]

George E. Bohner Dec. 1962 100 p 53 refs
(Contract DA-44-177-TC-725)
(TCREC-TR-62-90)

Research was undertaken in order to gain information that would lead to a better understanding of how some organic compounds are able to protect others from degradation while under the influence of high-energy irradiation. Cyclohexane was chosen as the solvent to be studied, with benzene, biphenyl, and naphthalene being the principal "protecting" additives. By identifying the various products formed in these solutions and determining the influence of dose and additive concentration on the rate of formation of the products, certain conclusions regarding the radiolytic degradation mechanisms can be made. The formation and subsequent reactions of radiolytically formed free radicals cause most of the degradation observed in pure cyclohexane. When an aromatic additive is present, it reacts with these radicals and competes with the normal degradation reactions. As a result, the additive disappears from solution at a rather rapid rate to form a small amount of simple compounds. The greater part of the reacted additive is found in the radiation-produced polymer. Each additive molecule appears to react with more than one free radical. The reaction of the additive with the free radicals results in a decrease in rate of formation of the products derived from the radiolysis of pure cyclohexane. Almost all the experimental results can be explained in terms of free radical mechanisms. A reaction degradation scheme is proposed which is consistent with the experimental results. Author

N63-14536 Parke Mathematical Labs., Inc., Carlisle, Mass.

MATHEMATICAL DESCRIPTIONS OF POLARIZATION AND RELATED PHENOMENA. PART II—QUANTUM MECHANICAL DESCRIPTION Scientific Report No. 12

Frank H. Rowsome III Dec. 1962 34 p 19 refs
(Contract AF 19(604)-7316)
(Rept. 7316-SR-12; AFCRL-63-27)

This paper is a review of current theories of the quantum mechanical property of polarization of beams of electrons and photons, and of the algebraic techniques describing polarization phenomena. The subject is approached in the perspective of measurement theory. Particular emphasis is placed on the mathematical foundations, the interrelations, and the conceptual structure of the theories. Author

N63-14547 Maryland U. Inst. for Molecular Physics, College Park

FORMAL KINETIC THEORY OF TRANSPORT PHENOMENA IN POLYATOMIC GAS MIXTURES

L. Monchick (Applied Physics Lab.) and E. A. Mason Apr. 1, 1963 59 p 45 refs Submitted for Publication
(Partially supported by NASA Grant NsG-5-59 and by BuWeps)
OTS: $5.60 ph, $1.97 mf

A rigorous, formal kinetic theory of multicomponent polyatomic gas mixtures is derived. Expressions are derived for the coefficients of shear viscosity, volume viscosity (which is proportional to a relaxation time), ordinary diffusion, translational and internal thermal conductivity, and thermal diffusion. Although the results are rather formal, a number of useful conclusions about the effects of inelastic collisions can be drawn without the necessity of detailed calculations. Conclusions and implications of the present formulas are discussed. Author

N63-14556 Stanford U. Stanford Linear Accelerator Center, Calif.

SPACE-CHARGE LIMIT AND CONFINEMENT IN PARTICLE ACCELERATION WITH HIGH-INTENSITY LIGHT WAVES Technical Report

J. J. Muray Jan. 1963 24 p 7 refs
(Contract AT(04-3)-400)
(SLAC 12) OTS: $0.50

From the condition of dynamical equilibrium between particles and fields (accelerating and space-charge fields) the maximum current which can be accelerated using optical frequencies has been calculated. This current maximum is proportional to the product of the wavelength λ and the accelerating field E ($I_{max} \approx \lambda E$). The average current for this type of optical particle accelerator is about 10^{-3} times the average current in microwave accelerators. However, the product of the average current and the accelerator length is approximately equal for the two types of accelerators. Because of the high field strength in these optical accelerators, the equivalent d.c. confinement force on the particles can be significant. This d.c. force in gradient fields is proportional to $\nabla_r E(r)^2$. This force may be used for confinement of a particle beam or even for medium-energy acceleration of the beam. Experiments to measure and utilize this effect are proposed. Author

N63-14557 Stanford U. Stanford Linear Accelerator Center, Calif.

OPTICAL PROPERTIES OF QUADRUPOLE MULTIPLETS FOR SECTOR FOCUSING IN THE TWO-MILE ACCELERATOR Technical Report

R. H. Helm Feb. 1963 35 p 5 refs
(Contract AT(04-3)-400)
(SLAC-14) OTS: $0.75

Results of this investigation are as follows: 1) The quadrupole requirements for the separated combinations, spaced doublet and spaced triplet, are rather modest. It would be practical to design for somewhere near the maximum usable transmission. 2) The quadrupoles become rather large for the contiguous combinations, close doublet and close triplet. If further analysis tends to favor one of these types, and if maximum transmission is desired, it might be necessary to design with considerably higher gradients than the 5 kilogauss/inch assumed here. For example, reduction of the quadrupole length by a factor of 2 would require an increase in gradient by a factor of $(2)^{\frac{2}{3}} \approx 1.5$ (i.e., 8 kilogauss/inch). A water-cooled conductor probably would be required. 3) The incompatibility of simultaneous transmission of high and low energy beams with maximum focusing strength is evidenced by the low energy cutoff. The alternatives are as follows: (a) decrease the lens spacing; (b) design for minimal focusing (e.g., admittance of corresponding to final energy $\leq$ 10 bev); and (c) program experiments so that multiple beam operations are confined to a fairly narrow energy band. Alternative (a) is undesirable due to expense and lens-alignment problems. It should be noted that, in any event, regions of tapered spacing will be required to match low energies into the regular-sector spacing; but this should be confined to a range of not more than one or two sectors per injector. Some combinations of alternatives (b) and (c) seem to be indicated. 4) None of the above results are sufficient criteria for final choice of the possible alternative systems. Study of the lens alignment problems will be the next step in formulating definite recommendations. I.v.L.

N63-14564 Argonne National Lab., Ill.

A RETROSPECTIVE ANALYSIS OF ASPECTS OF THE ALPR(SL-1) DESIGN

W. J. Kann and D. H. Shaftman Nov. 1962 53 p 24 refs
(Contract W-31-109-eng-38)
(ANL-6692)

The Argonne low power reactor was a prototype of a nuclear powerplant intended for use on DEW Line sites. It was constructed, tested, and operated normally for almost two years. Then in 1961, it was destroyed in a nuclear incident. This report examines the various aspects of the control system of the reactor in this perspective and discusses the investigations that followed the incident. It also presents ideas, fostered by the incident, which are relevant to the evaluation of the safety of reactor design and operation and of control system design. D.E.R.

N63-14567 Oak Ridge National Lab., Tenn.

EXPERIMENTAL DETERMINATION OF CORRECTIONS TO THE NEUTRON ACTIVATION OF GOLD FOILS EXPOSED IN WATER

W. Zobel Apr. 4, 1963 66 p 17 refs
(Contract W-7405-eng-26)
(ORNL-3407)

The corrections required to deduce unperturbed neutron fluxes from measurements with foil absorbers have been determined experimentally for the case of gold foils exposed in a light-water medium. The results are in good agreement with certain theoretical predictions. Author

N63-14568 Los Alamos Scientific Lab., N. Mex.

SPACE, ENERGY AND TIME DISTRIBUTION OF NEUTRONS AT THE GROUND-AIR INTERFACE CALCULATED BY MONTE CARLO CODE NHM

Wendell A. Biggers and Margaret R. Hemmendinger Mar. 25, 1963 111 p
(Contract W-7405-eng-36)
(LA-2390, Suppl.) OTS: $2.25

The calculations presented here have been obtained from the NHM Code, reported in LA-2390. All discussions of the problem in LA-2390 are pertinent to this supplement. In one calculation, only the shock wave was changed. In the other, both the shock wave and source height were altered. Author

N63-14571 Avco-Everett Research Lab., Everett, Mass.

VIBRATIONAL WAVE FUNCTIONS AND OVERLAP INTEGRALS OF VARIOUS BAND SYSTEMS

D. R. Childs Jan. 1963 27 p 5 refs
(Contract DA-19-020-ORD-5476)
(Avco-Everett Res. Rept.-147)

The vibrational wave functions of a diatomic molecule have been calculated for a Morse potential. A generating function for the polynomials has been obtained which enables one to derive recursion relationships among the polynomials. With the aid of these recursion relationships, overlap integrals between the various vibrationally excited electronic states have been calculated for a Morse potential, and a general expression has been obtained. Overlap integrals are exhibited for low vibrational quantum numbers for fifteen band systems. Author

N63-14625 Mound Lab., Miamisburg, Ohio

MOUND LABORATORY PROGRESS REPORT FOR OCTOBER 1962

G. R. Grove, L. V. Jones, J. F. Eichelberger, and E. A. Rembold Oct. 31, 1962 32 p 10 refs
(Contract AT(33-1)-GEN-53)
(MLM-1144)

Progress is reported in the following areas: Dacron filled diallyl phthalate and rheometers involved in plastics research; coincidence correction, polonium-208 and 209 in decay studies and in irradiated bismuth, high melting compounds of polonium and plutonium-238, and uranium-234 recovery; gas chromatography, carbon isotope separation and xenon studies; alpha and neutron source development; reactor fuels and materials development; calorimetry, reduction of heavy metal cations, and emission spectrography. A.R.B.

N63-14628 Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge

PROGRESS REPORT NO. XXXII

A. R. von Hippel et al Jan. 1963 72 p 76 refs
(Contracts Nonr-1841(10), Nonr-1841(88), AF 19(628)-395, AF 19(604)-6155, AF 33(616)-8353, AF 19(604)-8483, and AF-AFOSR-62-317)

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1. HIGH-DIELECTRIC-CONSTANT MATERIALS p 5-13 13 refs
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4. CRYSTAL PHYSICS p 33-48 20 refs
5. MAGNETICS p 48-58 10 refs
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N63-14634 California U., Berkeley. Lawrence Radiation Lab.

ON THE USE OF THE NUCLEAR ACTIVATION REACTION $^{18}O_{(\alpha,\eta)}{}^{21}Ne$ FOR ^{18}O ANALYSIS

Elie A. Shneour *In its* Bio-Organic Chemistry Quarterly Report, Sept. through Nov. 1962 Jan. 18, 1963 p 49-55 6 refs (See N63-14631 10-07) OTS: $2.50

Activation analysis remains the only reasonably simple and sensitive method of assay for ^{18}O in biological systems today. The assessment of the $^{18}O_{\alpha\epsilon}{}^{21}Ne$ nuclear activation reaction shows that the reaction may offer some promise in the assay of ^{18}O in biological material. But in order to achieve desired results, it will be necessary to improve the neutron detector sensitivity by either: (1) increase in Eα from 2.8 to 5 Mev or better, (2) purification of the alpha-source to high degree, (3) improved geometry of neutron detection, or (4) improved geometry of the activation system. D.E.R.

N63-14638 Israel Program for Scientific Translations, Ltd., Jerusalem

OPTICAL TRANSITION PROBABILITIES A Representative Collection of Russian Articles, 1924-1960

I. Meroz, ed. 1962 477 p 44 refs Transl. by R. N. Sen, O. Rones, and Z. Lerman Published for NSF and Dept. of Commerce
(PST Cat. No. 501; OTS-61-11437) OTS: $4.75

Anomalous dispersion, transition and transition states, resonance and oscillator strength, spectral intensity, thermal ionization, atomic line spectra and determination of flame temperatures, gf-values, atomic parameters, and solar observations are the main topics of these Russian papers. These properties are discussed mainly for a large, varied group of metals and some metal halides. D.E.R.

N63-14663 Oak Ridge National Lab., Tenn.

IN-AIR MEASUREMENTS IN THE VICINITY OF THE TOWER SHIELDING REACTOR II

F. J. Muckenthaler, L. B. Holland, and R. E. Maerker Apr. 8, 1963 74 p 4 refs
(Contract W-7405-eng-26)
(ORNL-3288) OTS: $2.00

A large number of measurements were made of the thermal-neutron fluxes and fast-neutron and gamma-ray dose rates in air due to radiation emitted by the TSR-II. These measurements, called "free-field" measurements because of a minimum of structural interference in the field, were performed for reactor-detector separation distances up to 100 ft, reactor heights up to 175 ft, and detector heights up to 145 ft. In addition, the reactor was encased in two different shields, identified as COOL-I and COOL-II, respectively, which were designed to give a fast-neutron to gamma-ray physical dose-rate ratio of 1.5 at large distances from the reactor and a thermal-neutron flux leakage that would cause ~30% of the gamma-ray dose rate in the field to be due to neutron captures by nitrogen. The significant difference between the two shields was in the hardness of the gamma-ray and fast-neutron leakage spectra, especially the latter. This report describes the conditions under which the measurements were made and reports the data. Author

N63-14666 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE MAGNETIC SUSCEPTIBILITY OF PYROLYTIC CARBONS
D. B. Fischbach Repr. from Proc. of the 5th Carbon Conf., Pa. State U., v. 2, June 1961 p 27-36 25 refs
(NASA Contract NAS7-100)
(JPL-TR-32-165)

The magnetic susceptibility of several oriented pyrolytic carbons (pyrolytic graphites) has been measured in the as-deposited condition, and after heat treatment at temperatures up to 3600° C. For pyrolytic carbons deposited at temperatures above 2000° C, the susceptibility is substantially larger than that of single-crystal graphite. However, it obeys the electron gas temperature-dependence equation of Pacault and Marchand. Heat treatment at temperatures above the deposition temperature causes the anisotropic part of the susceptibility (measured at room temperature) to decrease to a minimum value after treatments near 2900° C before leveling out at the plateau value characteristic of graphite for heat treatment temperatures above 3100° C. The enhanced as-deposited susceptibility is attributed to the combination of large crystallite diameter and turbostratic structure observed in these materials. Possible causes of the susceptibility minimum are suggested. There is some evidence that the susceptibility behavior of pryolytic carbons deposited at temperatures below 2000° C is similar to that usually observed in other pregraphitic carbons. Author

N63-14667 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
TAMING THE SUPERMAGNETS
Edmund E. Callaghan Repr. from Design, Feb. 14, 1963 p 2-6

Strong magnetic fields have been applied as "practical" engineering tools. One use is for metal forming. If these fields can be produced at reasonable costs, they will find other uses quickly. For example, future electric power generators will depend on intense magnetic fields. Technology of supermagnet design is growing and two approaches are being studied: (1) winding coils with a cryogenic superconductor that needs no further electrical power after energization and (2) winding coils with a cryogenic low-resistor, allowing large current flow. D.E.R.

24 PHYSICS, PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-14296 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.
LONG LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT Interim Scientific Report No. 1, Mar. 15, 1962 to June 15, 1962
S. Way et al June 11, 1962 87 p 2 refs
(Contract AF 33(657)-8311)

This review includes: (1) the closed loop duct; (2) a small experimental straight-through magnetohydrodynamic generator; (3) closed loop auxiliaries, which encompass a 100-kw plasma generator, an electrical conductivity measurement probe, a power source for the motor section, magnets for motor and generator sections, a cesium concentration monitoring system, and a seeding and makeup injection system; (4) thermodynamic basis of the loop design, which encompasses processes in the loop, factors affecting design, end leakage estimates, conductivity of the gas, and estimated loop performance; (5) heat transfer considerations; and (6) corrosion studies of tantalum in the presence of cesium vapor. I.v.L.

N63-14315 California Inst. of Tech. Graduate Aeronautical Labs., Pasadena
PRECURSOR PHOTOIONIZATION AND ELECTRONS
Hans Groenig Repr. from Phys. Fluids, v. 6, no. 1, Jan. 1963 p 142-144 12 refs
(Partially supported by NASA)
(*Its* Pasadena Publ. 543)

The observation and measurement of the visible radiation ahead of electromagnetically driven shocks has led to the theory that, at high Mach numbers, precursor signals consist of photoionization caused by radiation. The results of this experiment show that these precursors consist of both the diffusion of electrons from the region behind the shock front, as in conventional shocks, and radiation-caused precursors. Quantitative measurements of both types of precursors are made with spectrometric methods. D.E.R.

N63-14318 General Electric Co., Schenectady, N.Y.
SOME ASPECTS OF MHD POWER PLANT ECONOMICS
J. J. William Brown [1962] 23 p 7 refs Presented at Third Symp. on the Engineering Aspects of Magnetohydrodynamics, Univ. of Rochester, [N.Y.], Mar. 28-29, 1962

The results of recent research and engineering, including a high-strength superconducting magnet, have been utilized to design a 500 megawatt MHD-steam turbine combined-cycle electric-power generating plant. Wherever possible, presently available materials and standard practices have been utilized to give close approximation to such a plant as it might be designed and constructed in the near future. Performance calculations show the incentive behind the present efforts being expended in anticipation of the solution of the remaining problems. The capital costs presented for such a plant, while not discouraging, include areas of appreciable ignorance. The actual costs in these areas require better definition to confirm the attractiveness of the MHD principle for the central station application. The overall economics of MHD-steam turbine combined-cycle power-generating plants is compared with the moving target of today's cycles: fossil-fueled steam turbine, fossil-fueled steam and gas turbine combined cycle, and finally, nuclear-fueled steam turbine. This comparison emphasizes the urgency of successfully solving the present MHD problem areas if the MHD principle is to find wide use in electric utility central stations. Author

N63-14388 University of Southern Calif. Engineering Center, Los Angeles
FUNDAMENTAL EQUATIONS OF THE DYNAMICS OF AN IONIZED GAS [Summary Report]
T. Koga *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 55-56 refs (See N63-14379 10-11)

The kinetic equations of plasma dynamics is studied. These equations are found to be more complex than the Boltzmann equation for gases of neutral particles. Two encounters are found to influence the dynamic state: weak encounters that occur between two particles at distances shorter than the Debye distance and longer than the Landau distance; and strong encounters that occur at distances shorter than the Landau distance. It is concluded that these two encounters exert equal effects or, at least, comparable effects in most practical cases and that a collision term of the Boltzmann type may represent the encounters in a good and simple approximation. D.E.R.

N63-14389 University of Southern Calif. Engineering Center, Los Angeles
INTERACTION BETWEEN ELECTROMAGNETIC WAVES AND A PARTIALLY IONIZED GAS IN THE PRESENCE OF AN EXTERNAL MAGNETIC FIELD [Summary Report]

T. Koga *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 56-57 refs (See N63-14379 10-11)

Boltzmann-type equations are derived and solved for ions and electrons in a plasma model where molecules are partly ionized, by introducing "generalized moments" of the distribution functions of electrons and ions, containing the conductivity of a plasma to an oscillating field in the presence of a static magnetic field. The propagation of a radio wave in the plasma is investigated and seven frequencies characterizing the phenomena are discovered. The radio-frequency and the plasma frequency are approximated. D.E.R.

N63-14390 University of Southern Calif. Engineering Center, Los Angeles

BLAST WAVES IN ELECTROGASDYNAMICS [Summary Report]

K. Oshima *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 57-67 refs (See N63-14379 10-11)

By adding the Poisson equation to the set of equations used in conventional blast-wave analysis, the effects of the presence of charged particles in a gas are examined. Two similarity parameters result. Typical results are given for the density, pressure and electric potential distributions, and the propagation of the wave front. An example of a strong blast wave with significant ionization is given. D.E.R.

N63-14391 University of Southern Calif. Engineering Center, Los Angeles

FREE MOLECULE ELECTROSTATIC PROBE THEORY [Summary Report]

F. O. Smetana *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 67-72 refs (See N63-14379 10-11)

An attempt is made to combine an approximate Poisson equation with the free molecule flux equation so as to yield results relating the current in a cylindrical probe to the charged particle density in a rarefied high speed plasma flow. The following are assumed: that the plasma is composed of 3 species—positive ions, electrons, and molecules; that each of the species is in thermodynamic equilibrium locally; that the number densities of ions and electrons are equal and small; that collisions are to be neglected; that there is a uniform velocity for the stream; that the cylinder's diameter is small, that the cylinder field does not disturb the plasma, and that the change in the potential field of the cylinder may be neglected. The behavior may be observed thus: at ion speed greater than 10, the current collected is independent of cylinder potential; for large values of ion speed, the electron current is independent of electron speed; the ion current varies directly with ion speed; when ion speed approaches 0, the ion current at negative cylinder potentials is independent of potential when the charged particle density is high. D.E.R.

N63-14392 University of Southern Calif. Engineering Center, Los Angeles

PROPAGATION OF MICROWAVES THROUGH A FLOWING PLASMA IN THE PRESENCE OF A MAGNETIC FIELD [Summary Report]

K. Oshima *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 72-80 refs (See N63-14379 10-11)

The propagation of microwaves through the partially ionized gas flowing in a small 2-dimensional supersonic wind tunnel are studied experimentally. The results are compared with theoretical predictions based on the conventional tensor conductivity of a plasma in such a field. Quantities measured are: attenuation, phase shift, and rotation of plane of polarization. The experimental results given show good agreement with the theoretical prediction. D.E.R.

N63-14394 University of Southern Calif. Engineering Center, Los Angeles

HIGH-FREQUENCY ELECTRICAL BREAKDOWN IN LOW-DENSITY GAS [Summary Report]

P. C. Wilber *In its* Research on Rarefied Gasdynamics and Plasmadynamics Sept. 1962 p 84-95 refs (See N63-14379 10-11)

The criteria that must necessarily be satisfied for low-density fluid-dynamic research, especially for pressure measurement, are reviewed. Then, the gage types that provide measurements in the range of interest are listed. A secondary gage for pressure instrumentation is proposed and the theory is explained; then the project is summarized. The sensor, the outer electrode, is being designed, and tests are to follow. D.E.R.

N63-14462 Wisconsin U., Madison

NON-UNIFORM MAGNETOHYDRODYNAMIC SHOCK PROPAGATION, WITH SPECIAL REFERENCE TO CYLINDRICAL AND SPHERICAL SHOCK WAVES Technical Summary Report

Roy M. Gundersen Mar. 1962 36 p 17 refs
(Contract DA-11-022-ORD-2059)
(MRC-310)

The effects of area variations on the strength of hydrodynamic shocks are presented. Special emphasis is placed on cylindrical and spherical shock waves. As a uniform shock of arbitrary strength encounters an area variation, the shock strength is altered, resulting in the generation of a perturbation. This perturbation is determined and an area-shock strength relationship, valid for channels with finite continuous area variation, obtained. Particular area distributions are used to examine converging cylindrical and spherical hydromagnetic shocks. C.L.W.

N63-14530 Los Alamos Scientific Lab., N. Mex.

LAS'L CONTROLLED THERMONUCLEAR RESEARCH PROGRAM Quarterly Status Report, for Period Ending Feb. 20, 1963

Mar. 21, 1963 36 p
(Contract W-7405-eng-36)
(LAMS-2874) OTS: $0.75

Progress is reported in the following areas of thermonuclear research: picket fence II B, picket fence III, large bore gun, microwave Fabry-Perot interferometer, plasma lens to focus high-energy pions, transverse magnetic field injection, Scylla IV, Scylla I magnetic probes, framing camera for Scylla III, and capacitor and equipment development. R.C.M.

N63-14534 Boeing Scientific Research Labs., Seattle, Wash.

INTERACTION OF A PLANE JET WITH A MAGNETIC FIELD

F. D. Hains Dec. 1961 36 p 3 refs
(Flight Sciences Lab. Rept.-55; D1-82-0147)

An analysis is made of the distortion of a plane, supersonic free jet by a strong magnetic field. The field is created by a straight wire placed outside of the jet and normal to the plane of flow. The entire flow field is obtained numerically by the method of characteristics for several locations of the wire when the magnetic Reynolds number is small. The magnetic field tends to decelerate the flow to sonic velocity without the formation of shocks. The resultant force acting on the wire is found to vary linearly with the interaction parameter N for values of N as large as 0.1. Author

N63-14596 Wisconsin U., Madison, Wis.

MAGNETO-FLUID DYNAMICS OF BODIES IN ALIGNED FIELDS Technical Summary Report

K. Stewartson Nov. 1962 43 p 10 refs
(Contract DA-11-022-ORD-2059)
(MRC-360)

The motion of a perfectly conducting fluid past a fixed body in the presence of an aligned magnetic field can be regarded as the limit of a number of problems, viz: (1) when the fluid is a finite conductor, (2) an unsteady problem, (3) the magnetic and velocity fields are not parallel at infinity. The limits of these more general problems agree in predicting a force on the body and on the existence of upstream and downstream wakes. However, if the magnetic field is

fairly strong (1) does not predict a downstream wake whereas (2) and (3) do. An attempt to reconcile these limit results is made here. It is shown that the unsteady problem associated with a finitely conducting fluid and an aligned field is nonunique, but that by making an appeal to the theory of real fluids the conclusion of (1) and (2) can be obtained as special cases of the general solution. The steady problem, assuming that the conductivity is finite and the magnetic field is nearly aligned, is considered and it is shown that the flow fields predicted in (1) and (3) are limiting cases of this more general problem. The manner of the changeover from the solution for (1) to that for (3) is elucidated. Author

N63-14600 California U., Berkeley. Lawrence Radiation Lab.
CONTROLLED THERMONUCLEAR RESEARCH Semiannual Report, July through Dec. 1962
C. M. Van Atta et al Jan. 16, 1963 104 p refs
(Contract W-7405-eng-48)
(UCRL-10607) OTS: $2.25

The controlled thermonuclear research program is reviewed. The major projects and the highlights of development in plasma-stability theory and plasma experiments are covered, such as Project Alice, the development of the finite orbit theory, Toy Top, Levitron, Astron, Homopolar V, and Hothouse II. D.E.R.

N63-14608 General Applied Science Labs., Inc., Westbury, N.Y.
BACK SCATTERING OF A PLANE ELECTROMAGNETIC WAVE FROM AN INFINITE CYLINDER OF PLASMA WITH SMALL AXIAL GRADIENTS AND ARBITRARY RADIAL GRADIENTS OF ELECTRON DENSITY-NORMAL INCIDENCE
F. Lane, M. Abele, and S. Mariano Mar. 19, 1963 56 p 9 refs
(Contract NOrd-18053)
(GASL-TR-317)

This report describes an approximate diffraction calculation for cylindrical plasma structures having arbitrary (axisymmetric) radial property variation and weak axial property variation (small axial gradients of electron density). I.v.L.

N63-14612 France. Ministere de L'Air, Paris
REALISATION ET ETUDE D'UN ECOULEMENT CONTINU DE PLASMA DANS UNE TUYERE EN PRESENCE D'UN CHAMP MAGNETIQUE AXIAL [PRACTICAL APPLICATION AND STUDY OF A CONTINUOUS FLOW OF PLASMA IN A NOZZLE IN AN AXIAL MAGNETIC FIELD]
Marc-Henri Jacquelin Paris, Service de Documentation et d'Information Technique de l'Aeronautique (SDIT), [Feb.] 1963 78 p 10 refs
In French
(Its Publications Scientifiques et Techniques 391)

The effect of an axial magnetic field on the flow of a plasma in a convergent-divergent nozzle is studied experimentally. The effect of the pinching caused by the magentic field is demonstrated by the data obtained from a study of the flow in the nozzle of the plasma generator. The experimental laws linking the generating pressure and the heat transmission phenomena to the magnetic field are found. In certain cases, the temperature of the plasma is calculated at the neck of the nozzle. Trans. by M.P.G.

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-14306 General Electric Co., Evendale, Ohio
MONTE CARLO COMPUTATIONAL EXPERIMENTS ON SINGLE VACANCY MIGRATION IN CUBIC LATTICES [Final Report Mar. 15, 1962 to Mar. 15, 1963]
J. R. Beeler, Jr. Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 60 p 18 refs
(Contract AF 33(657)-8473)
(ASD-TDR-63-215)

A theoretical study of single vacancy migration in cubic AB alloys; i.e., simple cubic, body centered cubic, and face centered cubic (s.c., b.c., and f.c.c.), was performed using the Flinn-McManus Monte Carlo method for determining the direction of each vacancy jump. Migration histories of 10^4 to 3×10^4 jumps were considered. The computations dealt with the spatial properties of the vacancy migration process, per se, and the changes this migration induced in the order and configurational energy of the alloy. Physically, these computations correspond to watching a vacancy move through an alloy, originally in a state of equilibrium long-range order S_i at a temperature T_i, after a sudden change to a constant temperature T. Both the ordering and disordering processes were treated. In the case of ordering from a completely disordered state to the equilibrium state associated with the annealing temperature T, about 40 percent of the configurational energy change required to establish the new equilibrium state in the migration region was accomplished in 10,000 jumps. In the case of disordering from a state of perfect order, however, nearly 90 percent of the configurational energy change required to attain a new equilibrium state was accomplished in less than 30,000 jumps. Disordering was completed within 30,000 jumps, provided the annealing temperature was less than or equal to half the critical temperature. These results indicate that disordering is largely a local process but that ordering requires the combined effect of several vacancy path traverses through an elemental crystal volume. Because such large fractions of the configurational energy change required for a transition from one equilibrium state to another were accomplished in a relatively small number of jumps, it would appear that when excess vacancies exist they determine the initial ordering (disordering) rate. In this context, excess vacancies may be either quenched-in vacancies or vacancies produced by irradiation. Author

N63-14332 Stanford Research Inst., Menlo Park, Calif.
THE DIFFUSION OF LEAD IN POTASSIUM CHLORIDE Scientific Report No. 3
F. J. Keneshea, Jr., and W. J. Fredericks Nov. 29, 1962 39 p 34 refs
(Contract AF 19(604)-7231)
(AFCRL-63-15)

The diffusion of Pb^{++} ions in single crystal KCl has been studied over the temperature range 200° to 475° C. A radioactive tracer technique has been used in two types of measurements: diffusion from a deposited surface layer of $PbCl_2$, and diffusion from $PbCl_2$ vapor. For treating the data from the vapor diffusion experiments, a graphical method has been developed which enables D to be obtained as a function of Pb concentration. Author

N63-14359 Baird-Atomic, Inc., Cambridge, Mass.
RESEARCH IN INFRARED INTERFEROMETRY AND OPTICAL MASERS, VOLUME I Final Report [Mar. 1, 1957-Aug. 31, 1962]
Bruce Billings Bedford, Mass., Geophysics Research Directorate, Feb. 21, 1963 44 p refs For Volume II see N63-14360 10-25
(Contract AF 19(604)-2264)
(AFCRL-63-288)

The report is broken into two distinct and independent sections. The first section deals with the interferometric spectroscopy studies performed during the early years of this program, and includes results and conclusions. The second section deals with the maser research performed during the last six months of this program, and

includes theoretical considerations of photons in a laser cavity, techniques for isolating a single photon state, macroscopic effects associated with circularly polarized operation of a laser, and conclusions. Author

N63-14360 Baird-Atomic, Inc., Cambridge, Mass.
RESEARCH IN INFRARED INTERFEROMETRY AND OPTICAL MASERS, VOLUME II Final Report [Mar. 1, 1957-Aug. 31, 1962]
Bruce Billings Bedford, Mass., Geophysics Research Directorate, Feb. 21, 1963 26 p 9 refs For Vol. I see N63-14359 10-25
(Contract AF 19(604)-2264)
(AFCRL-63-288)

N63-14412 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.
RESEARCH IN ELECTRON THEORY OF CRYSTALS
S. I. Pekar Feb. 1963 248 p 73 refs Transl. by JPRS of "Issledovaniya po Elektronnoi Teorii Kristallov" Moscow State Publ. House of Tech. and Theoretical Lit., 1961
(AEC-TR-5575) OTS: $3.00

The states of conduction electrons in dielectrics and semiconductors with ionic crystal lattices are investigated to develop a more satisfactory explanation of the ordinary band theory of electrical conductivity. Local states of electrons, which play an important role in electric, photoelectric, and optical phenomena in these ionic lattice crystals are also discussed. A.R.B.

N63-14416 Services Electronics Research Lab., Baldock (Gt. Brit.)
CRYSTAL LAMPS
J. W. Allen, M. E. Moncaster, and J. Starkiewicz *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 11-20 13 refs Submitted for Publication (See N63-14414 10-01)

A new type of light source is described which uses recombination radiation from minority carriers injected at a p-n junction in gallium phosphide. Electrical and optical properties of the lamps are given, and some areas of application are indicated. Author

N63-14421 Services Electronics Research Lab., Baldock (Gt. Brit.)
CRYSTAL FIELD THEORY AND LUMINESCENCE IN ZINC SULPHIDE
J. W. Allen *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 39-41 3 refs Submitted for Publication (See N63-14414 10-01)

The results of luminescence and optical absorption experiments on zinc sulfide crystals containing Co^{2+} are related using crystal field theory. Some qualitative criteria for the relative probabilities of radiative and nonradiative transitions in ZnS-type phosphors were derived as follows: (1) radiative transitions are relatively more probable the greater the energy difference involved; (2) the greater the difference in the slope of the two states on the Orgel diagram, the greater the lattice interaction for a transition between the states and, therefore, the greater the probability of the energy being nonradiatively transferred to lattice vibrations. Applying these criteria, the $^4T_1(P)$-$^4T_1(F)$ transition in zinc sulfide should be predominantly nonradiative even though the radiative transition is optically allowed. Experimentally, excitation of zinc sulfide at 7,100 A did not produce emission at 7,500 cm^{-1} (1.3μ), which is in accordance with the transition criteria proposed. M.P.G.

N63-14422 Services Electronics Research Lab., Baldock (Gt. Brit.)
PULSED GASEOUS MASER
H. A. H. Boot and D. M. Clunie *In its* S.E.R.L. Technical Journal, Vol. 13, No. 1 Feb. 1963 p 42-43 4 refs Submitted for Publication (See N63-14414 10-01)

Molecular dissociation is proposed as the mechanism causing oscillations observed after the excitation pulse in optical gaseous masers. These oscillations were observed, following a pulsed R.F. or d.c. discharge in helium mixed with either neon or carbon monoxide, at wavelengths of 1.153μ and 1.069μ, respectively. In the helium/neon mixture, the oscillation reached a peak power of over 1 watt; in the helium/carbon-monoxide mixture, the peak power observed was 0.7 watts. These unusually high powers are thought to be due to the ease with which a high density of 2^3S metastable helium atoms is formed during the recombination of a well-ionized plasma; further, the high metastable density is obtained without a correspondingly high electron density. Conditions favoring resonant exhange processes are demonstrated for both neon and carbon monoxide. A similar oscillation noted in excited helium/carbon monoxide at the 1.454μ wavelength corresponding to the $3s^1P^o$ level is considered as further evidence that these oscillations are produced by selective population due to a dissociative mechanism and not by direct electron excitation. M.P.G.

N63-14476 Wisconsin U., Madison
DIFFRACTION OF PLANE ELASTIC WAVES BY A CRACK, WITH APPLICATION TO A PROBLEM OF BRITTLE FRACTURE Technical Summary Report
Michael Papadopoulos Feb. 1962 27 p 6 refs
(Contract DA-11-022-ORD-2059)
(MRC-294)

Examination is made of the diffraction of plane waves that is caused by a semi-infinite plane crack in an isotropic elastic solid. The half plane $x>0$, $y = 0$ is used to define the position of the crack; the edge of the crack is taken for the z-axis. The incidence of both plane shear waves and plane dilation waves is analyzed. A.R.I.

N63-14482 Massachusetts Inst. of Tech., Cambridge
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report
J. C. Slater, M. P. Barnett, G. F. Koster, and J. H. Wood et al Jan. 15, 1963 127 p 6 refs
(Contracts Nonr-184 (34; AF 19(628)-356; Grant NSF-G-24908)
(Rept. 47)

Symmetry properties of the space groups whose crystals have cubic Bravais lattices are presented. These space groups include O_h^5, O_h^7, T_d^2, O_h^9, O_h^{10}, T_h^7, O_h^1, and T_h^6. A number of the structures for crystals falling into these groups are worked out for the first time including that for garnet, which is probably the most complicated case for which symmetry properties have been investigated. In addition, progress is reported in: applying the Augmented Plane Wave (APW) method to real crystals; developing a preliminary Fermi surface model for gallium; studies of hexagonal symmetry; programing of the spin-orbit interaction as handled by the APW method; and relating ferroelectricity and lattice instability. Completed molecular studies include the probability of rotational excitation when a diatomic molecule is struck by a point particle, and a study of the methane molecule including accurate calculation of the integrals. M.P.G.

N63-14504 Istituto Universitario Navale, Naples (Italy)
MATCHING AND ABSORBING MATERIALS FOR MICROWAVE RADIATION Summary Report
G. Latmiral, G. Franceschetti, and R. Vinciguerra Feb. 28, 1963 46 p 12 refs
(Contract AF 61(052)-589)
(RADC-TDR-63-141)

In the case of matching, and almost rigorous synthesis procedure has been developed and successfully applied. When dealing with absorbers only, the analysis gives exact results. The synthesis is possible only under rather restrictive assumptions. Particular attention has

been devoted to matching or absorbing devices composed of a large number of sharp cones whose width and distance must be small in comparison with λ_o, supported by a thin plate of the same material. To calculate the equivalent e.m. parameters (variable with depth) of these devices, the theory of obstacle-type artificial dielectrics has been used. The reflection spectrum of such cone-tapered thin absorbers has been calculated. The possibility of reducing the probability of detection of a target by spreading, instead of by absorbing, the radiation incident on it, has been considered. Author

N63-14545 Technical Research Group, Syosset, N.Y.
RESEARCH ON PROPERTIES OF LASER DEVICES Third Quarterly Technical Summary Report, Dec. 1962 - Feb. 1963
M. Newstein and S. Rothberg, eds. [1963] 174 p 53 refs
(Contract AF 49(638)-673; ARPA Order-356-62; Proj. Defender)
(TRG-134-QRT-3)

Analytic work continued on the study of the variation of the power output versus frequency for a Doppler line shape, and on the modes of laser cavities. Oscillation at 3.2μ has been achieved in the optically pumped Cs laser in a sealed-off cell. The study of the possibility of utilizing photodissociated TlBr as a gaseous laser medium was pursued. Crystalline and glassy media for rare-earth ions were studied. Oscillation has been achieved in prism cavities formed by a corner-cube reflector facing either a flat or another corner-cube. Results are presented of a study directed toward maximizing the overall efficiency and angular brightness of mechanically Q-switched ruby oscillators. Author

N63-14645 Army Missile Command. Physical Sciences Lab., Redstone Arsenal, Ala.
THE EXCITED STATE-LATTICE INTERACTION OF THE F-CENTER
R. A. Shatas Feb. 28, 1963 15 p 21 refs
(RR-TR-63-1)

After an initial discussion of the importance of phonon processes in optical maser research, a brief survey of photon and phonon transitions occurring as a consequence of the optical exicitation of the F-center is presented. The existence of metastable excited F-states is postulated to account for a longer-than-predicted lifetime of the excited F-state. Infrared quenching, photoconductivity, and absorption modulation experiments are outlined for the purpose of testing the metastable state hypothesis. Author

N63-14659 Electronic Communications, Inc., Timonium, Md.
SELECTED SURFACE WAVE EXCITATION STUDIES Scientific Report No. 3
M. Cohn and M. J. King Mar. 1962 82 p 6 refs
(Contract AF 19(604)-5475)
(AFCRL-62-173)

This report on surface-wave excitation is divided into two parts. Part I is an analysis to determine the efficiency with which the dominant HE_{11} (dipole) mode can be launched onto a circular cross-section dielectric rod. The source consists of an infinitesimally thin magnetic-ring source, which is concentric with and has a larger radius than the dielectric rod, and whose magnitude is a sinusoidal function of the peripheral angle. Part II contains an analysis to determine the efficiency with which the dominant TM_{01} mode (Sommerfeld Wave) can be launched onto a finite conductivity circular rod. In this case, the source consists of an infinitesimally thin, uniform magnetic-ring source which is concentric with and has a larger radius than the rod. In each of these analyses, equations have been derived which yield the radiation and surface wave fields as a function of frequency, geometry, and the material constants of the surface-wave guiding structure. Curves of the computed launching efficiencies and plots of the far-field radiation patterns are presented. Methods of physically realizing the postulated excitation conditions for each of the problems are described. Author

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

N63-14243 Guggenheim Labs. for the Aerospace Propulsion Sciences. Princeton U., N. J.
SOLID PROPELLANT COMBUSTION MECHANISM STUDIES Fourteenth Progress Report for the Period April 1 to December 31, 1962
Richard B. Cole and Joseph Wenograd Jan. 31, 1963 26 p 8 refs
(Contract Nonr 1858(32); ARPA Order 23-62, Amend. 21)
(Aeronautical Eng. Rept. 446n)

This report describes research on the mechanism of combustion of solid propellants, carried out during the latter part of 1962. The major continuing goals of the research are the direct photographic observation of burning propellant surfaces and the measurement of surface temperatures by thermocouple techniques. Author

N63-14303 Rohm and Haas Co., Huntsville, Ala.
A METHOD OF CONFORMAL MAPPING AND THE DETERMINATION OF STRESSES IN SOLID-PROPELLANT ROCKET GRAINS
H. B. Wilson, Jr., and C. C. Fretwell Apr. 1, 1963 190 p 9 refs
(Contract DA-01-021-ORD-11878)
(S-38)

A numerical method is presented for mapping the exterior of a circle onto the exterior of a star-shaped contour consisting of an arbitrary number of identical and symmetrical parts. The method is employed to obtain the approximate transformation of an annulus onto a doubly-connected region having a circular external boundary and a star-shaped internal boundary of the type found in solid-propellant rocket grains. Numerical computations are presented for several different geometries. The determination of stresses in star-perforated, case-bonded solid-propellant grains due to effects of uniform boundary pressures and steady thermal gradients resulting from different constant internal and external temperatures is considered. Also, stresses in a star-perforated solid propellant rocket grain subjected to uniform transverse gravity loading with a stress free internal boundary and the external boundary bonded to a rigid case are considered. Author

N63-14311 Army Corps of Engineers, Washington, D.C.
ENGINEERING AND DESIGN. STORAGE, DISTRIBUTION, AND DISPENSING OF AIRCRAFT AND VEHICULAR FUELS
July 28, 1960 124 p
(EM-1110-345-332)

Criteria and instructions are presented that are to be followed in the design of facilities for receiving, storing, distributing, and dispensing fuels needed for aircraft and vehicles operated by the United States Army, Air Force, and Air National Guard units. A.R.B.

N63-14324 California U., Berkeley
EFFECT OF IGNITION GEOMETRY ON INITIAL FLAME ACCELERATION IN A SPARK IGNITED EXPLOSIVE GAS
A. J. Laderman, P. A. Urtiew, and A. K. Oppenheim Repr. from Combust. Flame, v. 6, no. 4, Dec. 1962 p 325-335 18 refs
(NASA Grant NsG-10-50; Contract AF 49(638)-166)

The influence of the geometry of ignition on the initial flame acceleration in spark ignited, stoichiometric hydrogen-oxygen mixtures at n.t.p. was investigated experimentally. Observations were made using schlieren photography with simultaneous pressure measurements in the vicinity of the igniter. It was found that flame acceleration increased when the distance between the ignition source and

the backwall became larger, provided that the flame was in continuous contact with the backwall. When the ignition source was extended farther into the tube so that the flame contacted the sidewalls before reaching the back end, its acceleration became independent of the distance of the point of ignition from the backwall. Experimental results were interpreted quite satisfactorily by means of a one-dimensional gas-wave dynamic analysis, demonstrating a significantly larger dependence of the flame-acceleration process upon the normal burning velocity than on the net amount of heat released per unit mass. Author

N63-14487 Naval Ordnance Lab., White Oak, Md.

THEORETICAL CALCULATIONS ON THE SHOCK INITIATION OF LIQUID TNT

Julius W. Enig and Fred T. Metcalf Nov. 1962 34 p 20 refs
(NOLTR-62-159)

Theoretical calculations describing the initiation phenomena in homogeneous liquid TNT, produced by shocks between 80 and 89 kilobars, are given. The initiation mechanism and growth to detonation are shown to be in semiquantitative agreement with experimental results. Upon entering the explosive, the shock wave initiates chemical reaction. After an induction time, the explosive cell that has been heated the longest detonates. The detonation wave, traveling in precompressed explosive with a velocity greater than the steady-state velocity in uncompressed explosive, overtakes the decaying initial shock and temporarily overdrives detonation in the uncompressed explosive. The numerical experiments, which are based on finite difference solutions of the partial differential equations of hydrodynamics, show the extreme sensitivity of the induction time to the initiating pressure in idealized one-dimensional gap tests. Of particular interest is the situation at onset of detonation after critical initiation by the attenuated shock from a short donor. In this case, the interface pressure is lower than that in the shock front, although the interface temperature is, of course, higher than that of the shock front. Author

N63-14488 Aerojet-General Corp. Solid Rocket Plant, Azusa, Calif.

INVESTIGATION OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS [Technical Operating Report, Jan. 1-Mar. 31, 1963]

D. J. Sibbett Mar. 3, 1963 17 p 5 refs
(Contract AF 49(638)-851; ARPA Order 24-60)
(Rept. 0372-01-13)

The "apparent flame strength" of the ammonia-oxygen system has been determined as a function of reactor pressure between 250 and 763 torr. A value of 0.81 g/cm^2-sec was obtained at 1 atmosphere, using the opposed-jet reactor with 2.0-cm nozzle separation. The second-order dependence of flame strength on reactor pressure indicated the overall order of the reaction. Based on the theoretical analysis of Spalding, a maximum volumetric consumption rate of ammonia at 1 atmosphere has been estimated as 4.5 g/cm^3-sec. The corresponding volumetric heat release rate was 2.4×10^4 cal/cm^3-sec for the ammonia-oxygen flame. The ethylene-air system was also studied as a function of pressure. The "apparent flame strength" was also shown to be approximately second-order. At 1 atmosphere, a value of 0.19 g/cm^2-sec was obtained as the limiting rate of combustion. The volumetric rate of ethylene consumption was 1.8×10^{-1} g/cm^3-sec; the volumetric heat release rate was 2.2×10^3 cal/cm^3-sec. Initial experiments have been carried out with oxygen-chlorine compositions in the oxidizer gas stream for opposed-jet studies of the reaction with ammonia. Measurement of "flame strength" for these systems was more difficult than with pure oxygen because of considerably increased flame instability. Author

N63-14535 Louvain U. Lab. for Inorganic Chemistry (Belgium)

ION PRODUCTION AND CONCENTRATION IN FLAMES Annual Summary Report No. 2

A. Van Tiggelen May 1962 44 p 19 refs
(Contract AF 61(052)-398)
(ARL-62-379)

An improved method for the measurement of flame conductivity is described. It takes into account the different perturbing side effects which interfere in flame conductimetry measurements. From the obtained results it appears that in all data published in the literature, the highest values of ion concentration in flames are the most likely. The method described has been applied to methane-oxygen flames (with or without additives). A comparative study is presented between ion concentration and the intensity of the different band spectra which are emitted in the same flames. A correlation between the OH^* emission and the amount of ions has been experimentally established. A complete description is given of the new improved equipment for ion extraction and identification in flames. It will make possible the investigation of any kind of flame burning at atmospheric pressure. Author

N63-14617 Stanford Research Inst., Menlo Park, Calif.

SOLID PROPELLANT MECHANICAL PROPERTIES INVESTIGATIONS Quarterly Progress Report No. III, Dec. 1, 1962-Feb. 28, 1963

Norman Fishman and James A. Rinde Mar. 25, 1963 31 p 1 ref
(Contract AF 04(611)-8388)
(Rept. 9)

Mechanical properties (consisting of results from constant strain rate, constant load, and constant loading-rate tests) of the two compositions AFBA-1 and AEBA-15 have been determined. Volume change data are being obtained by performing selected tests in the dilatometer. All work thus far has been with desiccated specimens tested under dry conditions. Dilatometric tests under conditions of constant load have verified the thesis that the linear strain-time portion of the creep curve represents a region where dewetting is the process which controls the creep rate. In this region, the volume was found to increase linearly with time. Constant strain tests in the dilatometer at 100° F showed that little or no volume change occurred after the selected value of constant strain was reached. Further, it was found that the physical state of a propellant was not dependent solely on strain but was also a function of path. When comparable extension rates under constant load and constant strain-rate conditions were used to extend the specimens to selected values of constant strain, it was found that different volume changes resulted, the higher volume change being associated with extension under constant load. Volume change measurements during constant strain-rate tests at 100° F showed that the volume change at large deformations increased with the strain rate and, further, that the minimum value of Poisson's ratio at large deformations decreased as the strain rate increased. Author

N63-14647 Feltman Research Labs., Picatinny Arsenal, Dover, N. J.

ESTIMATION OF THE MOISTURE CONTENT OF M61 IGNITER

Richard M. Abbott, Milton Roth, and Nathan M. Liszt Nov. 1962 16 p 5 refs
(PA-TM-1101)

A procedure has been developed for determining the moisture content of M61 igniter composition. A 5g specimen is boiled for 2 hours with 100 ml of a water-immiscible solvent such as trichloroethylene, and the moisture is collected in a return-solvent type of distillation receiver. The accumulated moisture and solvent are washed into a beaker with methanol and titrated using the Karl Fischer method. A blank determination is performed concurrently and the moisture content is calculated from the net titration. Recoveries of weighed amounts of water are quantitative. Moisture contents of samples of igniter composition are in the range of 0.6% to 0.8%. The procedure also appears applicable to the measurement of small percentages of moisture in many other types of mixtures containing compounds that react with the Karl Fischer reagent. Author

N63-14657 Polytechnic Inst. of Brooklyn, N. Y.
SHOCK WAVE INTERACTION WITH A BURNING PROPELLANT
Vito D. Agosta [1963] 31 p Presented at the Third Meeting of the Tech. Panel on Solid-Propellant Combust. Instability, Mar. 4-6, 1963

The interaction between a normal shock wave and an end-burning solid propellant is analyzed to obtain the characteristics of the reflected shock wave and the attendant effects on the combustion process and heat transferred to the solid propellant. The equations and boundary conditions for shock-wave reflection include a variable mass source represented as an exponential burning-rate equation, the existence of a contact surface, solid propellant compressibility, and gas-pressure effects on the adiabatic flame temperature. The equations are solved, assuming a hypothetical propellant, for a particular set of initial conditions and a variation in the burning-rate exponent. It is found that the variation in reflected shock-wave velocity, and in the pressure ratio across the reflected shock is quite small, about 0.2 percent and 0.5 percent, respectively. The greatest change (e.g., about 100%) occurs in the velocity of the contact surface which, as is known, follows particle paths. It is suggested that the contact-surface-propagation velocity is most suitable for instrumentation. Some phenomenological mechanisms are discussed concerning the value of the burning rate exponent under transient conditions. A short description of an end-burning solid-propellant rocket motor shock tube is given. Author

N63-14661 Atomics International, Canoga Park, Calif.
CAPSULE IRRADIATION OF UNALLOYED URANIUM AT HIGH TEMPERATURES
D. G. Harrington and J. B. Newton Apr. 15, 1962 35 p 8 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7098) OTS: $0.75

Cast and wrought specimens and restrained wrought specimens of unalloyed uranium were irradiated in the Materials Testing Reactor, as the first in a series of experiments to develop fuel materials for sodium cooled reactors. Average central temperatures ranged from 710° to 1280° F, and burnup ranged from 1230 to 2260 Mwd/MTU. The results show severe limitations of these fuel materials for advanced sodium cooled reactors, and agree substantially with data obtained from larger specimens irradiated in the SRE. The need for careful extrapolations of irradiation results from small accelerated test specimens is clearly indicated, especially in regard to diameter and length changes. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-14344 Martin Co., Baltimore, Md.
LUNAR LANDING STUDIES: PROPULSION SYSTEMS
J. Cochrane, O. Bumgardner, and M. Gruber Mar. 1962 44 p 2 refs
(Tech. Memo. 13; ER-12289)

Lunar landing propulsion studies are reported as follows: propellant selection; comparison of pressure-fed and pump-fed propellant-feed systems; propulsion-system optimization studies; and pressurization for pressure-fed propulsion systems. R.C.M.

N63-14354 Toronto U. Inst. of Aerophysics (Canada)
DEVELOPMENT OF A PROPULSION SYSTEM FOR POWERING A SELF-PROPELLED GETOL MODEL AIRCRAFT
R. C. Radford Dec. 1962 27 p 6 refs
(Contract AF 33(657)-8451)
(UTIA Tech. Note 64)

An estimate of the propulsion system requirements for the second UTIA GETOL model was determined from the data and theory contained in the available literature on ground effect phenomena. A dynamometer was designed and built to determine the torque-speed characteristics of model aircraft engines. Three engines were tested to find one that had the power required. A ducted-fan and straightener system which would utilize this power output was designed and built. It was installed in a cylindrical duct for testing. The pressure rise, power required, and efficiency as functions of volume flow at constant r.p.m. were determined for the fan and straightener combination. Author

N63-14370 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. für Strahlantriebe, Brunswick (W. Germany)
UNTERSUCHUNGEN ÜBER DIE ELEKTRISCHE MESSUNG MECHANISCHER GROSSEN BEI RAKETENTRIEBWERKSVERSUCHEN. TEIL I: ANWENDUNG UND KALIBRIERUNG VON TRAGERFREQUENZSYSTEMEN UND INDUKTIVEN MESZWERTAUFNEHMERN IN MEHRKANALMESZANLAGEN [STUDIES ON THE MEASUREMENT VALUES OF MECHANICAL SIGNIFICANCE IN ROCKET ENGINE RESEARCH. PART I: APPLICATION AND CALIBRATION OF CARRIER FREQUENCY SYSTEMS AND INDUCTIVE MEASURING INSTRUMENTS IN A MULTICHANNEL UNIT]
W. Buschulte and R. Zocher Sept. 1962 29 p In German
(DFL-185)

This report deals with the use of measurement value receivers and transmitters in the carrier frequency system of a multichannel unit for rocket engine research. Changes and improvements are described which were undertaken on standard finished equipment in order to increase the measurement accuracy and the margin of safety measurement. Tables and diagrams are presented which show the stability attained. A pressure transducer, which produces considerable improvement in temperature capacity, is discussed. Trans. by I.v.L.

N63-14413 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A NUCLEAR REACTOR CONCEPT FOR ELECTRIC PROPULSION APPLICATION
Jerry P. Davis Mar. 4, 1963 37 p 2 refs
(NASA Contract NAS7-100)
(JPL-TR-32-385) OTS: $3.60 ph, $1.31 mf

The generally desired startup and operational features of a turboplant nuclear reactor system for electric propulsion application are discussed and typical requirements enumerated. A reactor conceptual design in the 10-Mw heat range employing a nonsolid fuel element was chosen in order to circumvent uranium burnup-radiation damage limitations on core loading for lifetimes substantially in excess of 10,000 full-power hours. The primary and secondary loop flow cycles, nuclear characteristics, startup, and operational control concepts are briefly discussed. Author

N63-14436 Bundesministerium für Verkehr, Bonn (W. Germany)
BEITRAGE ZU DEN PROBLEMEN DER HEISSWASSERRAKETE [CONTRIBUTION TO THE PROBLEM OF THE HOT WATER ROCKET]
J. P. Etheimer Dusseldorf, VDI-Verlag GmbH, 1962 25 p 20 refs In German
(Its Luftfahrt-Forschungsberichte 12) Available from VDI: 22.20 DM

Problems of the hot water rocket are reviewed in the light of obtaining reliable data for the design of exhaust nozzles and to gain insight into the general behavior of boiling pressurized water under conditions of rapid expansion. The impulse storage capacity of water

is perceptibly reduced when air is incorporated during tanking of the rocket. The influence of this air incorporation was calculated for a widely used tanking method. The loss in impulse storage capacity at 50 atmospheres to 100 atmospheres final loading pressure was four percent. This loss must be considered in choosing the most suitable tanking method. A servovalve was chosen to provide the necessary rapid opening and closing of the exhaust nozzle. Results of measurements indicated that the operation time of this valve can be measured in tenths of seconds. The influence of the geometry of the tank size and of the nozzle on the equilibrium adjustment was studied on tanks of various sizes and shapes and on nozzles of various dimensions. Results indicated that, if the diameters of the cylindrical tank and the nozzle throat are proportional, the courses of the mass flow density would centralize only if the tanks had a similar geometric shape. I.v.L.

N63-14483 Jet Propulsion Lab. Calif. Inst. of Tech., Pasadena
THE DEVELOPMENT OF A HEATED-HYBRID GENERATED GAS PRESSURIZATION SYSTEM FOR PROPELLANT TANKS
Donald H. Lee and David D. Evans Feb. 15, 1963 56 p 16 refs
(NASA Contract NAS7-100)
(JPL-TR-32-375) OTS: $5.60 ph, $1.88 mf

This report describes the conception, design, development, and the experimental operation of a generated-gas pressurization system. The concept has been termed a "heated-hybrid" system since a monopropellant-hydrazine catalytic gas-generator system supplies decomposition gases to pressurize the fuel tank and a compressed helium system supplies gas to pressurize the oxidizer tank. The design and operation of each of the critical components comprising the system is discussed, and data are presented describing the overall performance of the system. Stable, repeatable tank pressures were obtained wherein the difference in absolute pressure levels between oxidizer and fuel tank was an average of ± 0.45 psi for a complete test series including start transients. The results of this experimental program indicate that substitution of this generated-gas pressurization system for the compressed helium pressurization system which was to have been used in the first model of the 6000-lb thrust stage of the Vega vehicle would have afforded a reduction in pressurization system weight of approximately 30%. Author

N63-14517 McGill U. Hypersonic Propulsion Lab., Montreal (Canada)
[A. RESEARCH ON PROBLEMS CONCERNED WITH HYPERSONIC AIR BREATHING ENGINES. B. DEVELOPMENT OF BASIC TEST FACILITIES] Annual Progress Report, Oct. 1961-Nov. 1962
S. Molder et al Nov. 1962 58 p refs
(Defence Research Board of Canada Grant DRB-9550-06)
(Memo. 62-11)

This progress report describes the work conducted during the period October 1961 to November 1962, in the Mechanical Engineering Research Laboratories of McGill University, by the Hypersonic Propulsion Laboratory. In all, 22 projects were studied during 1962. These projects may be divided into two types: (a) research on problems concerned with hypersonic air-breathing engines; and (b) development of basic test facilities. Of the 22 projects, 7 were completed, leaving 15 still in progress. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-14231 California U., Berkeley. Space Sciences Lab.
INTERPLANETARY GAS. VIII. ON THE ROLE OF RADIATIVE LOSSES
Peter Bodenheimer, John C. Brandt, and R. R. Robbins [1963] 27 p 36 refs Submitted for Publication
(NASA Grant NsG-243-62; ONR Grant Nonr(G)-00051-62)
(*Its* Ser. 4, Issue 7) OTS: $2.60 ph, $1.01 mf

The radiative losses due to free-free transitions, free-bound transitions, and permitted and forbidden line emission have been evaluated for all ions which are present in significant amounts in the extended solar corona from 4 to 215 sun radii. Most of the radiative losses occur interior to 15 sun radii, and they are dominated by line emission in the extreme ultraviolet and X-ray wavelengths. In general, the radiative losses are found to be unimportant, and the consequences of this result are discussed in terms of the semiempirical model recently presented by Brandt and Michie (1962). Author

N63-14288 Alaska U. Geophysical Inst., College
THE MAGNETIC MOMENT OF MODEL RING CURRENT BELTS AND THE CUTOFF RIGIDITY OF SOLAR PROTONS
W. C. Lin (Iowa State U.) and S.-I. Akasofu Repr. from J. Geophys. Research, v. 68, no. 4, Feb. 15, 1963 p 973-977 13 refs
(NASA Grant NsG-201-62; Contract N9onr-93803)

The magnetic moment M_R of the ring current is calculated for model ring-current belts, together with their magnetic fields along an equatorial radius. A graph shows the relation between the ratio M_R/M_E (M_E = the magnetic moment of the earth) and the intensity ΔH of the ring current field at the equator on the earth's surface. It gives possible ranges of the ratio M_R/M_E for observed values of ΔH and approximate upper limits of both M_R/M_E and ΔH for each belt. On the basis of diagram, the entry of low-energy solar protons is discussed, and it is shown that the ring current alone cannot produce the drastic reductions of apparent cutoff rigidity of solar protons observed by detectors carried by balloons and satellites. Author

N63-14293 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROTONS FROM 0.1 TO 5 MEV AND ELECTRONS OF 20 KEV AT 12 EARTH RADII DURING THE SUDDEN COMMENCEMENT ON SEPTEMBER 30, 1961
R. A. Hoffman, L. R. Davis, and J. M. Williamson Washington, NASA, Mar. 1963 10 p 3 refs
(NASA TN D-1700) OTS: $0.50

During the period around the sudden commencement of the magnetic storm on September 30, 1961, the ion-electron detector aboard Explorer XII observed fluxes of low energy protons and electrons while the satellite was at 12 earth radii and outside the magnetosphere. About 25 minutes before the sudden commencement, the proton intensity increased; and, 8 minutes before, the omnidirectional intensity suddenly jumped. The maximum flux of about 2×10^5 protons/cm^2-sec-ster above 140 Kev was attained ½ hour after the sudden commencement. Thereafter the intensities varied irregularly with time, and displayed fluctuations in anisotropy that were dependent on the direction of the local magnetic field. The energy spectrum was independent of both time and intensity. The energy density of the proton spectrum (1×10^{-9} erg/cm^3) was too small to account for the observed compression of the earth's field on the sunlit side during the magnetic storm. Time-coincident with the sudden jump in proton intensities, an electron flux first appeared and reached its peak value of 3×10^6 electrons/cm^2-sec-ster in the 10 to 35 Kev range about 1 minute before the observance of the sudden commencement on the earth's surface; it continued for about 10 minutes and then disappeared. The detection efficiency for electrons places an upper limit of 2×10^5 electrons/cm-sec-ster for the remainder of the storm. Author

N63-14328 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
SOLAR ENERGETIC RADIATION—A BRIEF REPORT AND BIBLIOGRAPHY OF U. S. RESEARCH 1960-1962
J. A. Simpson Feb. 1963 20 p 83 refs
(EFINS-63-9)

N63-14426 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE LOW FREQUENCY POWER SPECTRUM OF COSMIC-RAY VARIATIONS DURING IGY
David Stern Washington, NASA, Mar. 1963 21 p 41 refs
(NASA TN D-1684) OTS: $0.75

The power spectra of cosmic-ray variations, as recorded by neutron monitors at various locations, is computed and analyzed. The frequency range of the variations covered (from 1/200 to 1/2 per day) is found to contain only one significant peak, contributed by the well-known 27-day variation. By use of the power spectrum, a quantitative estimate of the latitude dependence of the 27-day variation may be made. From this, the average rigidity dependence of the modulation amplitude is deduced, and is found to be essentially the same as that of Forbush decreases. The average was taken over the period July 1957 to December 1958, during which the peak decreased significantly. Irregular variations were also investigated, as was the correlation with magnetic activity. It is found that the irregular variations have approximately the same latitude dependence as the 27-day peak, decreasing roughly exponentially with increasing frequency. There was some correlation between magnetic activity and cosmic-ray variations, but it showed no clear recurrence tendencies. A general review of power spectral analysis, with emphasis on points relevant to this work, is included, and the conclusions, along with the connection between Forbush decreases and the 27-day variation, are discussed. Author

N63-14537 Committee on Space Research (COSPAR), The Hague (Netherlands)
TO THE RESULTS OF THE CHARGED PARTICLE THREE-ELECTRODE TRAP EXPERIMENTS IN THE SECOND RADIATION BELT AND IN THE OUTERMOST BELT OF CHARGED PARTICLES
K. I. Gringauz, S. M. Balandina, G. A. Bordovsky, and N. M. Shutte 1962 9 p 17 refs Presented at the COSPAR Meeting, Washington, D.C., May 1962

Results are presented of the laboratory experiments with charged-particle traps identical with those installed on Soviet space probes. It is shown that the traps efficiently record fluxes of electrons with energies on the order of tens of Kev. The data presented confirm the conclusion about the absence of soft electron fluxes in the outer radiation belt. Author

N63-14551 Harvard Coll. Observatory, Cambridge, Mass.
CLASSIFICATION OF SOLAR PROMINENCES FOR SUNSPOT CYCLE NO. 19—1957
Donald H. Menzel and F. Shirley Jones Jan. 1963 58 p
(Contract AF 19(604)-4962)
(Its Scientific Rept. 17; AFCRL-63-205)

The positions, areas, and behavior classifications of all prominences observed at the Sacramento Peak Observatory, Sunspot, New Mexico, during 1957 are tabulated and their distribution with solar latitude is analyzed. Author

N63-14558 High Altitude Observatory, Boulder, Colo.
THE SOURCE OF SOLAR FLARES
James W. Warwick Repr. from Publ. of the Astron. Soc. of the Pacific, v. 74, no. 439, Aug. 1962 p 302-307 5 refs
(NASA Grant NsG-136-61)

The solar photosphere is considered as the source of solar flares by assuming that flares are produced by fast particles escaping into the solar atmosphere. The greatest depth in the photosphere from which a 300-Mev proton can emerge is calculated to be 480 km. The complex fields needed to accelerate particles to these energies can exist only in and below the photosphere. An examination of the possible energy sources available to solar flares (magnetic fields of atmosphere and hot flare gases) indicates that subphotospheric changes in current systems are probably responsible for flares. R.C.M.

N63-14714 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ARTIFICIAL RADIATION BELT MADE ON JULY 9, 1962
Wilmot N. Hess Washington, NASA, Apr. 1963 23 p 5 refs Previously processed as a reprint; see N63-10554 01-28
(NASA TN D-1687) OTS: $0.75

The available information on the artificial radiation belt formed by the July 9, 1962, high-altitude nuclear explosion is reviewed. Data from Injun-SR-3, Telstar I, Traac, and Ariel I are combined to form one picture of the artificial belt. The data are consistent to about a factor of 3. The flux map obtained in this way is used to calculate the flux encountered by several satellites. These show reasonable agreement with data on solar cell damage. Preliminary data on particle lifetimes are presented. Particles at $L>1.30$ are expected to last several years on the basis of coulomb scattering. Crude calculations of shielding are made to indicate the doses received inside various vehicles. Author

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-14253 Smithsonian Astrophysical Observatory, Cambridge, Mass.
POSSIBLE CONTRIBUTIONS OF SPACE EXPERIMENTS TO COMETARY PHYSICS
P. Swings Dec. 15, 1962 24 p 20 refs
(NASA Grant NsG-87-60)
(SAO Special Rept.-111) OTS: $2.60 ph, $0.92 mf

Possible space experiments for observing the geometric, spectroscopic, and photometric behavior of comets are described. These experiments are proposed because an interpretation of cometary data may yield essential data on the formation and evolution of the solar system and the nature of interplanetary space. The various ways of obtaining significant planetary data are examined. These include: (1) far ultraviolet observations by orbiting astronomical observatories; (2) using artificial gaseous comets formed by high-altitude release of gases such as NH_3; (3) orbiting artificial cometary nuclei such as blocks of CO_2 or NH_3 ice, perhaps with an addition of meteoric material; and (4) using fly-by probes of a comet such as Encke's periodic comet. The significance of the data that would be obtained by each of these methods is predicted. M.P.G.

N63-14254 Smithsonian Astrophysical Observatory, Cambridge, Mass.
SATELLITE ORBITAL DATA
I. G. Izsak Jan. 23, 1963 39 p
(NASA Grant NsG-87-60)
(SAO Special Rept.-113) OTS: $3.60 ph, $1.37 mf

Smithsonian Astrophysical Observatory smoothed elements, SAO mean elements, and sun perigee data have been derived for the following satellites: Explorer I, April 1 through July 1, 1962; Vanguard II, March 31 through June 30, 1962; Vanguard III, March 31 through June 30, 1962; Explorer VII, March 31 through June 30, 1962; Explorer VIII, April 1 through July 1, 1962; and Explorer IX, March 31 through June 30, 1962. A.R.B.

N63-14268 Smithsonian Astrophysical Observatory, Cambridge, Mass.

ON THE SECULAR DECREASE IN THE INCLINATION OF ARTIFICIAL SATELLITES

Rajendra C. Nigam Jan. 21, 1963 12 p 8 refs
(NASA Grant NsG-87-60)
(SAO Special Rept.-112) OTS: $1.60 ph, $0.80 mf

Merson and King-Hele (1958) noticed a marked decrease in the inclination of Sputnik II and suggested among the possible causes that of the rotation of the atmosphere. Wildhack (1958) studied the effect of the transverse atmospheric drag on the inclination, and showed a secular decrease caused by atmospheric rotation. In view of the smallness of this effect, he was skeptical that it could be used to obtain any definite information on winds and tides in the upper atmosphere. Sterne (1959), however, from his analysis of the inclination of Sputnik II, suggested the probability of an atmospheric wind blowing from west to east at about 13 mph, at heights between 150 and 250 km. The aim of this paper is to extend this study by utilizing the increased accuracy in the orbital elements that has become available in the past four years. Author

N63-14291 National Aeronautics and Space Administration, Washington, D.C.

THE EXPLORATION OF SPACE

Hugh L. Dryden [1963] 8 p Presented at Fifth Annual Conf. on Recent Developments in Mathematics and the Sciences, Oklahoma State U., Stillwater, Feb. 23, 1963
OTS: $1.10 ph, $0.80 mf

A general review is presented of the results, future plans, and motivation for space exploration. The main features of the atmosphere, ionosphere, radiation belts, and magnetic field are sketched, and the manned and unmanned spaceflight programs are discussed. The peaceful use of space is exemplified by meteorological satellites such as Tiros and communications satellites such as Echo, Relay, and Telstar. M.P.G.

N63-14292 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

EARTH—VENUS TRAJECTORIES, 1964

V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer Jan. 30, 1963 789 p 9 refs
(NASA Contract NAS7-100)
(JPL-TM-33-99, Vol. I, Pt. B) OTS: $31.00 ph, $23.87 mf

This volume is one of a set of five giving key characteristics of Earth-to-Venus trajectories during the period 1964 to 1970. This period is divided into five 120-day launch intervals spaced about 19.2 months apart. During each interval, trajectory characteristics are given for flight times of from 70 to 220 days in 2-day steps. Thus each volume contains 9,120 trajectories. The applicability of these books may be extended by noting the 8-year cyclic recurrence of Earth-Venus trajectories. Thus trajectories in 1972 are very nearly identical to 1964 trajectories; 1973 trajectories are very nearly identical to 1965 trajectories, etc. Simply by updating the trajectories by 8 years, the results may be reapplied. In generating such a large amount of data, it is impossible to check the correctness of each number. Should the reader detect any errors, the authors would appreciate being advised. Companion volumes give the characteristics of Earth-Mars trajectories during the period 1964 to 1977. Author

N63-14304 Utah U. High Velocity Lab., Salt Lake City

ABSOLUTE LUMINOSITY, SIZE, AND VELOCITY OF INDIVIDUAL LABORATORY MICROMETEORS

J. C. Bryner, E. P. Palmer, and R. R. Kadesch July 1962 80 p 28 refs
(Contract AF 04(647)-942)
(Tech. Rept. UU-10; BSD-TDR-62-270)

Single, submicron sized, artificial meteors with velocities as high as 10.2 km sec^{-1} have been observed for the first time. These particles are found in the spray resulting from the impact of 7/32-inch steel balls upon massive iron targets in a vacuum detection chamber with the pressures ranging between 0.1 and 1.0 mm of mercury. Absolute luminosity measurements of the individual spray particles are made, representing the first such data obtained under controlled laboratory conditions and for particles of known size and mass. A new functional form is proposed to represent the luminous efficiency τ for micrometeors in the pressure, size, and velocity ranges used in this study. The meteor constants β and σ are determined for the individual spray particles. The average measured diameters of these particles is about 0.1μ. The highest measured velocity of a spray particle in this study is 10.2 km sec^{-1}, the value calculated by extrapolation to its point of origin. This observed maximum is considerably lower than several previously reported values, but agrees with later, more careful measurements. Author

N63-14331 RAND Corp., Santa Monica, Calif.

A DIFFERENTIAL CORRECTION PROCESS FOR NEARLY CIRCULAR ORBITS

F. T. Smith Mar. 1963 55 p 8 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3554-PR)

This Memorandum is part of a continuing series of investigations in orbital mechanics, and has particular application to orbit determination and spaceflight guidance problems. It extends work in certain of the references cited and provides explicit equations, not readily available elsewhere, for a differential correction process. It also serves as a supplementary reference for orbital parameter estimation and orbit transfer studies currently underway. This work should be of interest to those concerned with astrodynamics and spaceflight guidance problems. Author

N63-14334 Flugwissenschaftliche Forschungsanstalt, Munich (W. Germany)

PHYSIK DER ATMOSPHÄRE UND RAUMFAHRT [PHYSICS OF THE ATMOSPHERE AND SPACE FLIGHT]

F. Wilckens Sept. 1962 92 p 192 refs In German; English abstract
(FFM 56)

Atmospheric conditions for design and operations of space vehicles and their relationships to engineering processes are outlined. Atmospheric data and a comprehensive bibliography are presented. Author

N63-14345 Martin Co., Baltimore, Md.

LUNAR LANDING STUDIES: TRAJECTORY ANALYSIS

W. Pragluski and F. Santora Mar. 1962 32 p
(Tech. Memo. 14; ER-12290)

A technique for obtaining specific lunar trajectories, developed during the Apollo study, has been programed on the IBM 7090 computer. This technique, called VOICE, allows the engineer to pick the conditions for a specific mission and obtain, with relative ease, the appropriate integrated trajectory. Constraints, such as launch time flexibility, launch time tolerance, launch azimuth restrictions, flight time, pericynthion altitude, lunar orbit inclination and orientation, lunar landing site location, and transearth trajectory to specific earth landing sites with specific inclinations can be specified in the program. Trajectories obtained by the VOICE technique which are particularly

applicable to lunar landing module engineering are summarized; these include injection conditions, midcourse corrections, lunar orbit, landing and takeoff, and abort trajectories. M.P.G.

N63-14346 Martin Co., Baltimore, Md.

LUNAR LANDING STUDIES: EARTH AND LUNAR ORBITAL RENDEZVOUS TECHNIQUES

W. Progluski and J. Porter Mar. 1962 23 p
(Tech. Memo. 16; ER-12292)

The rendezvous maneuver used in the earth orbit or lunar orbit rendezvous missions must include all phases of flight from launch off the surface to docking. The trajectories in this interval all contribute to the rendezvous maneuver when considering launch time tolerances, launch frequencies, and mission planning. This report will first describe the various techniques which can be used to accomplish the rendezvous maneuver and then present some of the data used in making a choice between the various techniques. Author

N63-14347 Martin Co., Baltimore, Md.

LUNAR LANDING STUDIES: FLIGHT OPERATIONAL CONCEPTS

F. E. Bradley and A. L. Guess Mar. 1962 19 p
(Tech. Memo. 21; ER-12297)

This report presents the current thinking as to basic features of the operational concepts for accomplishing lunar landing mission by three methods: direct, earth orbit rendezvous, and lunar shuttle. Emphasis is placed upon those operational aspects which have an influence on design of the lunar landing module. Details of the various phases of operation are continuously being generated, and will be published in future technical memoranda. Author

N63-14349 Martin Co., Baltimore, Md.

LUNAR LANDING STUDIES: LUNAR LANDING MODULE STUDY. ELECTRICAL POWER AND ENVIRONMENTAL CONTROL

K. Porter Mar. 1962 27 p
(Tech. Memo. 28; ER-12304)

Electrical power and environmental control systems studies conducted to date have evaluated only a few of the possible configurations applicable to a two-man lunar-landing vehicle. Basic system-weight requirements have been determined for power systems consisting of silver-zinc batteries, ion membrane fuel cells, and a combination of these two methods. The configuration and weight requirements for the environmental control system, including temperature-control provisions for the fuel cells, have also been determined. Other areas of thermal control study have reached the stage of first-phase completion. These studies were concerned with evaluation of heat-pump operation and determination of thermal-radiation magnitudes incident on a vertical space radiator while on the bright side of the moon. Current study covers preliminary evaluations of thermal control problems associated with the direct landing module. Results achieved to date are presented. Author

N63-14356 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

THE FIRST FLIGHT TO THE PLANET MARS (PERVYI POLET K PLANETE MARS)

London, Ministry of Aviation, Jan. 1963 14 p Transl. by J. W. Palmer from Pravda, Dec. 15, 1962
(RAE Library Translation 1026)

An account is given of the automatic interplanetary station "Mars I" launched from the Soviet Union on 1st November 1962. The layout and equipment of the vehicle are described with photographs and diagrams; its trajectory is discussed; and a brief description is given of its operation during the first two months of flight. Author

N63-14397 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE EXPLORER XVI MICROMETEOROID SATELLITE. SUPPLEMENT I, PRELIMINARY RESULTS FOR THE PERIOD JANUARY 14, 1963, THROUGH MARCH 2, 1963

Earl C. Hastings, Jr., comp. Washington, NASA, Apr. 1963 15 p 2 refs
(NASA TM X-824) OTS: $0.50

Penetration experiments on the Explorer XVI micrometeoroid satellite indicate that as of March 2, 1963, 24 of the 0.001-inch-thick beryllium-copper pressure cells have been punctured, and 6 of the 0.002-inch-thick beryllium-copper pressure cells have been punctured. Corresponding puncture rates are 0.034 puncture/sq ft/day and 0.02 puncture/sq ft/day for these two thicknesses. A tentative conversion of these rates to rates for equivalent thicknesses of aluminum has been made and the results have been compared with previously predicted rates. The Explorer XVI data lie above the lowest estimate far below the highest estimate. As of March 2, 1963, no breaks have occurred in either the 0.002-inch or the 0.003-inch copper-wire card detectors. Between January 14, 1963, and March 2, 1963, additional punctures of the 0.00025-inch aluminized Mylar shields of both of the cadmium sulfide cells have occurred. Evaluation of the degradation of a bare test solar cell and of a test solar cell with 0.006-inch glass cover between December 16, 1962, and January 17, 1963, indicated values of roughly 14 percent and 12 percent, respectively (with respect to a 3/16-inch-silica-covered cell). Telemeter temperatures and component surface temperatures have remained within acceptable operating limits. Author

N63-14404 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ANALYTICAL THEORY OF THE STRETCH YO-YO FOR DE-SPIN OF SATELLITES

Joseph V. Fedor Washington, NASA, Apr. 1963 21 p 3 refs
(NASA TN D-1676) OTS: $0.75

An analysis of an advanced type of yo-yo for satellite de-spin is made. The analyzed stretch yo-yo consists of a weight, a spring, a wire, and end fittings, or simply a weight, a spring, and end fittings. Equations of motion are developed for the system but, because of the complex nature of the equations, they are not solved explicitly. By using a novel method of analysis, algebraic complexity is circumvented and simple design equations are derived. A straightforward step-by-step procedure is given for the design of the stretch yo-yo. The results calculated from the equations clearly indicate that the stretch yo-yo is less sensitive to satellite spin-up errors and uncertainty in the spin moment of inertia than is the conventional rigid yo-yo. Author

N63-14406 National Aeronautics and Space Administration, Washington, D.C.

EVALUATION OF INFRARED SPECTROPHOTOMETRY FOR COMPOSITIONAL ANALYSIS OF LUNAR AND PLANETARY SOILS

R. J. P. Lyon (Stanford Res. Inst.) Apr. 1963 136 p 43 refs
(NASA Contract NASr-49(04))
(NASA TN D-1871) OTS: $2.75

A preliminary feasibility study of infrared analytical techniques for the study of the lunar surface has been made, including absorption studies of 370 rock and mineral samples, and reflection studies of 80 rocks. Spectral information was collected in the wavelength range 2.5 to 25 microns (4000 to 400 cm^{-1}). Emittance spectra have been calculated from the reflectance data for several of the most important rock types. Author

N63-14587 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPRAY EJECTED FROM THE LUNAR SURFACE BY METEOROID IMPACT

Eugene M. Shoemaker, Henry J. Moore (Geol. Survey), and Donald E. Gault
(NASA TN D-1767) OTS: $1.00

Experimentally determined mass-size distributions of fragments ejected from craters formed in rock by hypervelocity impact have been combined with estimates of the rate of impact and mass distribution of interplanetary debris which strikes the lunar surface to find

the rate and mass of fragments sprayed up from the lunar surface. It is shown that the flux of particles of a given mass ejected from the lunar surface will be at least three and probably four orders of magnitude greater than the flux of the impacting interplanetary debris of the same mass. Experimentally determined distributions of mass with velocity indicate that almost all of the debris is ejected at less than lunar escape velocity (2.4 km/sec) and contributes to secondary impact events. A small fraction of the ejecta, however, will leave the lunar surface at velocities greater than the escape speed. These results imply the presence of a lunar dust cloud of flying particles. The major fraction of the cloud is estimated to be a few kilometers deep with a spatial density at the lunar surface of the order of 10^5 to 10^7 times the spatial density of the interplanetary debris. These particles, together with the interplanetary debris, provide a powerful eroding agent that will continually abrade the lunar surface and reduce rubble to finer sizes. The inference to be drawn is that there must be at least a thin layer of dust-sized particles on the lunar surface—a layer which is being constantly agitated and stirred by the impacts to form a heterogeneous mixture of material from the entire surface of the moon. It is to be expected that lunar probes and vehicles will be subjected to higher rates of impact when immersed in the dust cloud than during the earth-moon voyage. Author

N63-14668 Stanford Research Inst., Menlo Park, Calif.
INFRARED SPECTRAL ANALYSIS OF THE LUNAR SURFACE FROM AN ORBITING SPACECRAFT
R. J. P. Lyon and Eugene A. Burns Oct. 16, 1962 Repr. from Proc. of 2nd Symp. Remote Sensing Environment, Mich. U., Oct. 16, 1962 p 309-327 21 refs
(NASA Contract NASr-49(04))

Absorption and specular reflection analyses have been used to test the feasibility of infrared compositional analysis of lunar materials in the wavelength range 2 to 25 microns. In a NASA-sponsored study, over 300 minerals and rocks have been examined and the applicability of the techniques clearly established. By applying Kirchhoff's law to the spectral reflectance data, under thermal equilibrium conditions one can obtain the spectral-emittance curves at any given temperature. Major rock types may be readily differentiated from one another at lunar ambient temperatures. Author

N63-14677 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PHOTOGRAPHY OF THE MOON FROM SPACE PROBES
Manfred Eimer Jan. 15, 1963 26 p 17 refs
(NASA Contract NAS7-100)
(JPL-TR-32-347) OTS: $2.60 ph, $0.98 mf

Photography of the moon from space probes is an essential early step in lunar exploration. From the vicinity of the earth, even diffraction-limited systems cannot conceivably be capable of providing sufficient optical resolution within the next few decades. Aspects of the photometric properties of the moon that are important to an understanding of photographic problems are briefly examined. Geometric problems relating to impacters, orbiters, and landers are reviewed. The selection of system components is discussed, and examples of designs and their properties are given. Author

N63-14678 Geophysics Corp. of America, Bedford, Mass.
A STUDY OF THE METEOROLOGY OF MARS AND VENUS Quarterly Progress Report No. 3, Apr. 6 thru July 5, 1962
G. Ohring, O. Cote, and W. Tang [1962] 9 p 2 refs
(NASA Contract NASw-286)
OTS: $1.10 ph, $0.80 mf

The effect of a cloud cover in a simple radiation balance model of the atmosphere of Venus is investigated theoretically in order to ascertain the credibility of Venus' 600° K surface temperature. This surface temperature is required in both the greenhouse model and the aelosphere model of Venus' atmosphere. It is in accord with microwave measurements, but is more than twice the surface temperature that would prevail if Venus had no atmosphere. The assumptions made when the cloud cover is introduced into the radiation balance model are: (1) the cloud is at a high elevation and radiates as a black body at a temperature of 235° K, and (2) there is no absorption of radiation above the cloud top. An equation is derived for radiative balance at the top of the atmosphere, and the computations indicate that the cloud cover enhances the greenhouse effect of the atmosphere of Venus. In addition to the study of Venus, two technical reports were published as a result of studies of the surface and atmospheric temperature distributions of Mars. M.P.G.

N63-14679 Lockheed Missiles and Space Co., Sunnyvale, Calif.
A STUDY OF INTERPLANETARY TRANSPORATION SYSTEMS Final Report
S. Ross et al June 2, 1962 156 p refs
(NASA Contract NAS8-2469)
(Rept. 3-17-62-1) OTS: $11.50 ph, $4.88 mf

The major criteria for planning of manned interplanetary missions are investigated. The following areas are covered: nonstop interplanetary round trips; stopover interplanetary round trips; space missions launched normal to the ecliptic; precise trajectory calculations and the investigation of guidance sensitivities; and nonstop trips passing both Mars and Venus. R.C.M.

N63-14713 General Electric Co. Space Sciences Lab., Philadelphia, Pa.
EXPERIMENTAL PLANETARY ENTRY RESEARCH FOR MARS AND VENUS—1962
T. K. Pugmire et al Oct. 1962 175 p 40 refs
(NASA Contract NAS7-100; Contract AF 49(638)-931)
(TIS-R62-SD-84) OTS: $12.50 ph, $5.45 mf

Discussions are presented of the following: (1) prediction of stagnation-point heat transfer for Mars and Venus ballistic entry based on high-enthalpy shock-tube studies; (2) the development of an experimental facility, 6-inch arc-driven helium shock tube, capable of simulating planetary entry velocities up to 45,000 ft/sec.; (3) the performance of several "class" ablation materials relative to air in simulated atmospheres of Mars and Venus at gas enthalpies proportional to entry velocities of 22,000 to 28,000 ft/sec.; (4) the relative efficiency of nitrogen atoms and molecules in producing dissociation as determined by studies of combustion-generated shock structures; (5) development of a versatile equilibrium thermochemistry computer program for planetary atmospheres; (6) assessment of effect of Venus ionosphere on communication attenuation; and (7) recommended future experimental studies. Author

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-14355 Toronto U. Inst. of Aerophysics (Canada)
ATTITUDE STABILITY OF ARTICULATED GRAVITY-ORIENTED SATELLITES PART I—GENERAL THEORY, AND MOTION IN ORBITAL PLANE

B. Etkin Nov. 1962 56 p 2 refs
(UTIA Rept. 89)

A theoretical framework is presented for analyzing the rotational and relative motions of compound satellite systems. It consists essentially of expressions derived for the forces and moments acting on the constituent bodies, and of their utilization in Lagrange's equation to find the equations governing the motion of the system. The method is applied to a specific system intended for passive attitude stabilization, and numerical examples are calculated. The design is found to provide damping to ½ amplitude in as little as one-third of an orbit, and to have small response to orbit ellipticity. Author

N63-14626 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SURVEY OF LARGE SPACE CHAMBERS

R. T. Hollingsworth Washington, NASA, Apr. 1963 15 p
(NASA TN D-1673) OTS: $0.50

Construction has been authorized for a number of large thermal-vacuum chambers to simulate orbital altitudes in the environmental testing of complete spacecraft. The proposed facilities shall be capable of simulating the low temperatures, solar and earth radiation, and vacuum of outer space. Outlined in this report are the individual specifications and capabilities of each of the proposed space-simulation facilities. Since the field of space simulation is growing rapidly, it is recognized that this survey will be out of date upon issue.

Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-14611 Duke U., Durham, N.C.

ON THE VACUUM AIR MISSILE BOOST Interim Technical Report No. 3

Sudhir Kumar, Jai R. N. Rajan, and James J. Murray Durham, N. C., Army Research Office, Sept. 1962 119 p 14 refs
(Contract DA-ORD-31-124-60-G63; Proj. Mountainwell)
(AROD-N-62.4)

A comprehensive study of the concept of the vacuum-air missile-boost system is presented in this report. An improved theoretical analysis of the problem of estimating velocities imparted by the system has been developed. The influence of size of the muzzle chamber on the back pressure has been studied, and solutions for the case of completely turbulent flow in a tube with large muzzle chamber have been presented. A nondimensional study of the problem has been carried out. The terminal velocities have been plotted as surfaces for different values of the nondimensional parameters. These surfaces given an overall picture of the dependence of the terminal velocity on the various parameters. Critical length curves for different missile weights have been obtained, and the diameters of the launch tubes for a limiting acceleration of 8 g's have been computed. The experimental results were obtained from tests on two laboratory models having 20-ft.-long tubes and tube diameters of 3 in. and 1¼ in. in diameter, respectively. Good agreement has been found between theory and experiment, and the causes for discrepancy are discussed in the report. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-14343 National Aeronautics and Space Administration, Washington, D.C.

NASA TO LAUNCH FOURTH SATURN ROCKET News Release No. 63-61

Mar. 24, 1963 27 p
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

The fourth Saturn I space vehicle (SA-4) will be launched to test the "engine-out" capability of the booster system. One inboard engine will be shut down 100 seconds after lift-off. The burning time of the other seven engines will be extended somewhat to compensate for the loss of thrust, and the overall performance is expected to be about the same as that of an ideal eight-engine flight. This flight is scheduled as the final booster-only test of the Saturn rocket; the next Saturn (SA-5) will have a live second stage and the capability of placing 20,000 pounds in earth orbit. M.P.G.

N63-14351 Flügwissenschaftliche Forschungsanstalt, Munich (W. Germany)

BIBLIOGRAPHIE ÜBER METEOROLOGISCHE RAKETEN UND SATELLITEN SOWIE IHRE MESSERGEBNISSE [BIBLIOGRAPHY OF METEOROLOGICAL ROCKETS AND SATELLITES AS PERTAINS TO MEASUREMENT DATA]

F. Wilckens Apr. 1962 55 p 500 refs In German and English
(FFM-55)

This bibliography on measurements made by meteorological rockets and satellites is arranged in the following subject categories: meteorological rocket systems in general, specific rocket systems, meteorological instrumentation, rocket probes of the stratosphere and mesosphere, and meteorological satellites. Trans. by M.P.G.

N63-14411 Smithsonian Astrophysical Observatory, Cambridge, Mass.

CATALOGUE OF SATELLITE OBSERVATIONS, NO. C-33

Beatrice Miller Jan. 30, 1963 73 p
(NASA Grant NsG-87-60)
(SAO Special Rept. 116) OTS: $7.60 ph, $2.39 mf

Observations of satellites by SAO Baker-Nunn camera stations, Moonwatch teams, U. S. and foreign observatories, military installations, Phototrack stations, and miscellaneous observers are cataloged. The satellites and the periods during which the observations were made are as follows: Explorer V, January 1 through June 30, 1962; Transit 4A, January 1 through June 30, 1962; Injun Solar Radiation 3, January 1 through June 30, 1962; Explorer XII, January 1 through Sept. 19, 1962; Orbiting Solar Observatory, March 7, 1962; Cosmos 2, April 8 through May 16, 1962; Cosmos 2 Rocket, April 8 through May 4, 1962; Cosmos 3 Rocket, May 4 through May 17, 1962; S 51/UK1 Rocket, April 28 through May 4, 1962; Tiros V, June 20 through August 8, 1962. M.P.G.

N63-14428 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RESULTS OF MICROMETEORITE PENETRATION EXPERIMENT ON THE EXPLORER VII SATELLITE (1959 IOTA)

H. E. La Gow and L. Secretan Washington, NASA, Apr. 1963 9 p 5 refs
(NASA TN D-1722) OTS: $0.50

The results of a micrometeoroid penetration experiment aboard satellite 1959 IOTA (Explorer VII) are presented. The sensors and their arrangement aboard the satellite are described, and the telemetry record obtained during flight is analyzed critically. It is concluded that one penetration through one cell occurred on the 16th day, and that it was caused by a particle approximately 10 microns in diameter. Author

N63-14546 Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOGUE OF SATELLITE OBSERVATIONS, No. C-31
Beatrice Miller Jan. 28, 1963 57 p
(NASA Grant NsG-87-60)
(SAO Spec. Rept. 114) OTS: $5.60 ph; $1.91 mf

A catalog of satellite observations from January 1 through June 30, 1962, is presented. Observations of the following satellites are included: Explorer I (1958 Alpha); Vanguard II (1959 Alpha I); Vanguard III (1959 Eta); and Explorer VII (1959 Iota 1). The observations listed include those from SAO Baker-Nunn camera stations and Moonwatch teams, U.S. and foreign observatories, military installations, Phototrack stations, and miscellaneous observers. M.P.G.

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-14250 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FATIGUE BEHAVIOR OF MATERIALS UNDER STRAIN CYCLING IN LOW AND INTERMEDIATE LIFE RANGE
Robert W. Smith, Marvin H. Hirschberg, and S. S. Manson Washington, NASA, Apr. 1963 57 p 12 refs
(NASA TN D-1574) OTS: $1.50

A series of constant-strain range tests was made for a wide variety of materials producing fatigue lives varying from a few cycles to about one million cycles. The specimens were subjected to axial, compression-tension, low-frequency fatigue about a zero mean strain. Load range was measured periodically throughout each test, enabling an analysis of fatigue results in terms of elastic, plastic, and total strains. Materials tested were AISI 4130 (soft and hard), AISI 4340 (annealed and hard), AISI 52100, AISI 304 ELC (annealed and hard), AISI 310 (annealed), AM 350 (annealed and hard), Inconel X, titanium (6A1-4V), 2014-T6, 5456-H311, and 1100 aluminum, and beryllium. Fatigue-life relations between elastic, plastic, and total strain components were established. For metallurgically stable materials, straight-line fits of the logarithmic elastic strain-life and plastic strain-life data produce a relation that agrees well with the total strain-life data. The strain-life data are also used to explain changes in susceptibility to stress concentrations over a large life span and to rate correctly the relative notch sensitivities of the four test materials that experienced nontest-section failures in comparison with the other materials. Author

N63-14271 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ROOM-TEMPERATURE SHEAR AND COMPRESSION TESTS OF STIFFENED PANELS WITH INTEGRAL OR ATTACHED COOLING CIRCUITS
Marvin B. Dow and Ralph O. Whitley Washington, NASA, Mar. 1963 44 p 3 refs
(NASA TN D-1499) OTS: $1.25

The results of tests on 22 Z-section-stiffened panels loaded in shear and compression are presented and discussed. The sheet used in the fabrication of 16 of the panels had cooling circuits attached to, or made an integral part of, the sheet. The panels were tested at room temperature with water flowing in the cooling circuits at the design values of inlet pressure and flow rate. The results indicated that the presence of the cooling circuits did not significantly penalize the load-carrying capability of the panels. Structural loads had little effect on the flow rate of water in the cooling circuits until severe sheet buckling at high load levels had occurred. Water leaks developed in the cooling circuits of a few panels before gross panel failure, but in no cases were the leaks caused by rupturing of the cooling circuits due to load. Supplemental tests showed that turbulent flow existed in the cooling circuits at the design values of inlet pressure and flow rate. Author

N63-14279 National Aeronautics and Space Administration, Washington, D.C.
OBSERVATIONS ON THE ROLE OF NONLINEARITY IN RANDOM VIBRATION OF STRUCTURES
Richard H. Lyon (Bolt, Beranek and Newman, Inc.) Washington, NASA, Mar. 1963 47 p 17 refs
(NASA Contract NASr-47)
(NASA TN D-1872) OTS: $1.25

The effects of nonlinearity in several clamped-clamped beam vibration problems are reviewed. Possible effects are: jump or instability phenomena, amplitude limiting effects, and distortion of probability densities. Studies of prototype panel-frame structures show similar behavior. The necessity for extending these efforts to built-up structures is emphasized. Also, estimates for the onset on nonlinearity based on two simple models are made to show how one can be guided in experimental design by quantitative-empirical considerations. Some theoretical techniques are appraised for their applicability to the structures problem. In particular, two approximation methods are singled out for detailed comment. The possibilities of a more creative use of experimental analysis and a closer tie between theoretical and experimental effort in structures research are explored. Author

N63-14309 Tokyo U. Inst. of Industrial Science (Japan)
EIN BEITRAG ZUR LÖSUNG DER MITWIRKENDEN BREITE [A CONTRIBUTION TO THE SOLUTION OF THE EFFECTIVE WIDTH]
Takeo Fukuda Feb. 1963 55 p 10 refs In German; English synopsis
(*Its* Serial 36, vol. 12, no. 5)

The reduced width of flange, i.e., the effective bandwidth, which is of great importance in bridge design, is reviewed. The stress distribution in the flange is expressed by the Airy stress function of trigonometric series, expressing thereby the bending moment by Fourier series. This procedure does not differ from that of von Kármán or of Metzer. The effective flange width λ, however, is determined from $\lambda = \frac{\int_0^b \sigma_x dy}{\sigma_{x,max}}$ where $\sigma_{x,max}$ is the maximum value of the flange stress σ_x, that occurs along the juncture of the flange to the web, together with the condition that the $\sigma_{x,max}$ shall agree with the uniform flange stress that will be obtained by the usual calculation of the imagined beam flanges of the width λ. The effective bandwidth varies in general with the ratio of the flange width to the span length $\beta = b/l$, type of beam, type of loading, cross section of the beam, boundary condition of the side of the flange, and Poisson's ratio. The effective bandwidth is also, in general, not constant lengthwise along the beam. Of the above-mentioned factors, the first three exert surpassing influence upon the effective bandwidth. The ratio λ/b decreases strikingly with the increase of β. When β becomes greater than a certain value, that mainly depends upon the type of beam, the effective bandwidth becomes approximately proportional to the

span length. The numerical computation of the effective width requires, in many cases, some labor of calculation. It can, however, be easily done by electronic computers. Many tables and graphs of the ratio of the effective width to the flange width are presented.
I.v.L.

N63-14319 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
THE EFFECT OF THE RIGIDITY OF THE GLUELINE ON THE FATIGUE STRENGTH OF 2024-T ALUMINUM ALLOY SPECIMENS WITH AN ADHESIVE BONDED REINFORCING PLATE ON BOTH SIDES
A. Hartman and P. de Rijk Feb. 1962 20 p 2 refs
(Supported by the Netherlands Aircraft Development Board)
(NLR-TN M.2096)

Light alloy specimens consisting of a 2 mm 2024-T alclad sheet reinforced with doubler plates of 1 mm were loaded in fluctuating tension. Redux and Metlbond 4021 were used as adhesive with glueline thicknesses of about 0.05 and 0.5 mm. The Metlbond bonded specimens had a higher endurance than the Redux bonded specimens indicating that in applications like doublers a low rigidity of the adhesive is favorable. The Redux bonded specimens with a thick glueline showed porosity and failed by loosening of the doublers. Thick Redux gluelines with gas bubbles have to be avoided. Author

N63-14321 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
NON-DESTRUCTIVE AND DESTRUCTIVE TESTS ON REDUX BONDED SINGLE AND DOUBLE LAP-JOINTS WITH VARIOUS GLUE LINE THICKNESSES
A. Hartman and J. B. de Jonge Mar. 1962 33 p 12 refs
(Supported by Netherlands Aircraft Development Board)
(NLR-TN M.2099)

A series of Redux-bonded single and double lap-joints with nonporous glue layers of various glueline thicknesses were tested ultrasonically by means of the Fokker Bond Tester. Tensile shear tests were carried out after completion of the ultrasonic tests. Bond Tester indications were in good agreement with theoretical results, indicating the instrument's ability to detect glueline stiffness. The static strength of double lapjoints turned out to be nearly independent of glueline thickness; for single lapjoints a strong dependence on glueline thickness was found. The analysis of the tensile shear test of adhesive bonded joints is discussed. Author

N63-14335 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
SOME NEW RESULTS AND METHODS IN PHOTOELASTICITY USING ARALDITE B (EINIGE NEUE ERGEBNISSE UND ERFAHRUNGEN BEI SPANNUNGSOPTISCHEN VERSUCHEN MIT ARALDIT B)
E. Moench (Munich Res. Inst.) London, Ministry of Aviation, Dec. 1962 18 p 10 refs Transl. by H.C. Ransom from Konstruction (W. Berlin), v. 13, no. 8, 1961 p 289-298
(RAE Library Translation 1022)

The epoxy resins are at present the preferred materials for photoelasticity. At the Münich Research Institute, their main uses were studied, the experimental techniques developed, and in recent years experiments were carried out with warm hardening Araldite B.
Author

N63-14369 J. G. Engineering Research Associates, Baltimore, Md.
PLASTIC BEHAVIOR OF CONTROL SURFACES AND PLATES SUBJECTED TO AIR BLAST LOADING. PART II: DETAILED ANALYSIS AND NUMERICAL RESULTS FOR BEAM TYPE STRUCTURES Technical Report No. 2
Joshua E. Greenspon Mar. 1962 23 p 10 refs
(Contract DA-36-034-ORD-3081RD)

A detailed analysis and numerical results illustrating the elastic and plastic behavior of control surfaces and plates are presented. The purpose of this analysis was to determine the ultimate load-carrying capacity of a vehicle which is dependent upon the residual load-carrying ability of a beam-type structure of a ductile material. The report includes hinge moment relationships, equations of motion, and illustrative examples. D.E.R.

N63-14454 Wisconsin U., Madison
TRANSITION THEORY OF SHEET-BENDING Technical Summary Report
B. R. Seth May 1962 13 p 4 refs
(Contract DA-11-022-ORD-2059)
(MRC-326)

Transition theory of elastic-plastic deformation, developed in recent papers, is applied to the plastic bending of a rectangular sheet. No semi-empirical yield condition is assumed. It comes out of the equations. Further, the orthogonality assumption shows that the only possible form when it becomes plastic is circular. The analysis also separates the two regions of yielding under extension and compression, which correspond to the turning points of the nonlinear differential equations arising out of the equations of equilibrium.
Author

N63-14464 California U., Berkeley. Inst. of Engineering Research
FINITE TWISTING AND EXPANSION OF A HOLE IN A RIGID/PLASTIC PLATE
R. P. Nordgren and P. M. Naghdi Feb. 1963 33 p 9 refs
(Contract Nonr-222(69))
(*Its* Ser. 131, Iss. 19; Tech. Rept. 19)

This paper is concerned with the finite twisting and expansion of an annular rigid/plastic plate in the state of plane stress. The plate, bounded by two concentric circles one of which may extend to infinity, is subjected in its plane to the combined action of pressure on the inner boundary and a couple due to circumferential shear. A detailed solution which includes the effect of isotropic workhardening is obtained with the use of Tresca's yield function, and its associated flow rules and the corresponding solution with the use of Mises' yield function and its associated flow rules is also discussed. Numerical results are given which illustrate the influence of twisting on the expansion of a hole in an infinite plate. Author

N63-14468 Illinois Inst. of Tech., Chicago
THE CARRYING CAPACITY OF CONICAL SHELLS UNDER CONCENTRATED AND DISTRIBUTED LOADS
Philip G. Hodge, Jr., and John A. De Runtz, Jr. Feb. 1963 41 p
(Contract Nonr-140604)
(DOMIIT-1-22)

The yield point load of a simply supported conical sandwich shell loaded at its vertex through a rigid central boss is found for a material obeying the Tresca yield condition. Exact solutions are found for relatively shallow thick shells with medium size bosses, and upper and lower bounds are established for all shell configurations. It is found that for a given shell, the yield-point load is an increasing function of the boss size. For very small boss sizes and for very flat shells, the yield-point load is a decreasing function of the edge angle, whereas for larger bosses and steeper shells it increases with edge angle. These conclusions are compared with those for shells of uniform thickness. Author

N63-14490 Weidlinger (Paul), New York, N.Y.
FORCED VIBRATIONS OF AN ELASTIC CIRCULAR CYLINDRICAL BODY OF FINITE LENGTH SUBMERGED IN AN ACOUSTIC FLUID PART II—COMPUTATIONAL PROCEDURES AND NUMERICAL EXAMPLE Technical Report No. 2
Melvin L. Baron and Alva T. Matthews Jan. 1963 53 p
(Contract Nonr-3454(00)FBM)

The method, covered previously, for the evaluation of the pressure field in an infinite acoustic fluid due to the harmonic excitation

of an elastic circular cylindrical body of finite length is illustrated. The application of the method to problems in general is discussed, and numerical results are given for the axisymmetrical problem; e.g., the cylinder excitation is independent of θ and the response is given by the $n = 0$ component only. It is concluded that the theory used here may find useful applications in evaluating the response in a fluid due to the harmonic excitation of large transducers. R.C.M.

N63-14498 Southern Research Inst., Birmingham, Ala.

THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO VERY HIGH TEMPERATURES Final Report, 1961-1962

Frank J. Digesu AEC Div. of Tech. Inform., Oct. 27, 1962 89 p
(Contract AT(40-1)-2694)
(TID-17887) OTS: $2.00

A complete facility was developed previously to determine the true stress-strain properties of brittle materials to 5200° F. A concentrated program of sophistication and refinement of the entire system was completed to provide maximum performance of all components. The modifications, refinements, and additional equipment developed are discussed in detail in this report. The stress-strain properties of several materials were determined at temperatures from room temperature to 5000° F. The materials investigated included two densities and two grain orientations of ZTA graphite, ATJ graphite, and 99.5% pure alumina. To determine the most practical configuration of tensile specimen, the notch effect on ATJ graphite was also investigated. The results obtained for all materials are presented in the report. As a result of these data, the validity of some existing theories of stress analysis is seriously questioned. Author

N63-14511 Wisconsin U., Madison

A BOUNDARY LAYER THEORY FOR UNSYMMETRIC DEFORMATIONS OF CIRCULAR CYLINDRICAL ELASTIC SHELLS Technical Summary Report

M. W. Johnson, Jr. (Ph. D. Thesis-MIT, 1957) May 1962 55 p
24 refs
(Contract DA-11-022-ORD-2059)
(MRC-318)

The derivation of two-dimensional systems of differential equations for stresses and displacements of thin elastic shells from the known equations of linear three-dimensional elasticity is investigated in the light of studying unsymmetric deformations. The method used is that of dimensional analysis together with expansion in powers of a dimensionless parameter of the solution of the equations of the three-dimensional theory for the semi-infinite cylindrical shell under self-equilibrating end loading. Linear dimensions characterizing the problem are the radius a, thickness h of the shell, a length l associated with the rate at which the given end loads vary around the circumference of the middle surface and an axial length scale which is a function of the other three scales. Associated with length scales $l < (ah)^{1/2}$ are boundary-layer phenomena not exhibiting the physical characteristics of shell behavior. Therefore, as a part of the definition of a shell, consideration of load length scales is restricted in the range $(ah)^{1/2} \leq l \leq a$. This leads to two problems where length scale l takes on its extreme values. The results are as follows: (1) When $l = (ah)^{1/2}$, the axial length scale is also $(ah)^{1/2}$, and an expansion in the powers $h/2a$ is quite straightforward. (2) When $l = a$ it is found that two axial length scales must be used, a short length $(ah)^{1/2}$ and a long length $a(a/h)^{1/2}$. The solution is obtained by superposition of expansions in powers of $h/2a$ corresponding to each length scale. Insofar as the problem of obtaining a valid first approximation is concerned, the results confirm the validity of the hypotheses of conventional shell theory with regard to (1) the Euler-Bernoulli assumptions concerning normals to the middle surface and (2) the neglect of transverse shear and normal stress components in the stress-strain relations of the three-dimensional equations. However, it is shown that certain terms must be retained in the three-dimensional equations which are of higher order in h/a due to the fact that they may make a first order contribution to the resulting shell equations. Using the results of this paper, the equivalence is shown of the different expressions found in the literature for change of curvature components of the middle surface. I.v.L.

N63-14548 Michigan U. Coll. of Engineering, Ann Arbor

EFFECT OF LONG-TIME CREEP ON STRUCTURAL SHEET MATERIALS Second Progress Report

H. R. Voorhees and J. W. Freeman Apr. 1962 15 p
(Contract AF 33(616)-8334)
(Rept. 04583-10-P)

The amount of creep deformation of the mechanical properties of structural sheet materials were studied under stress at 550° F. The exposure stress was selected at 67,000 psi. Exposure time periods of 2000, 5000, 12,000, and 30,000 hours were selected to show the effects of exposure time. Tests designed to study using results from shorter-duration exposures to predict property changes to be expected during long service life are also included. Hardness values show very little change, if any, from creep exposure. D.E.R.

N63-14549 Michigan U. Coll. of Engineering, Ann Arbor

EFFECT OF LONG-TIME CREEP ON STRUCTURAL SHEET MATERIALS Third Progress Report

H. R. Voorhees and J. W. Freeman Nov. 1962 15 p
(Contract AF 33(616)-8334)
(Rept. 04583-17-P)

Changes in mechanical properties as a result of prolonged exposure under stress at 550° F are studied to furnish data which will be useful in evaluating materials for the construction of a Mach 3 transport aircraft. Unnotched, wide-notched, and normally notched sheet materials have been exposed to creep conditions for various time lengths (2000, 5000, 12,000 and 30,000 hr.), at high temperatures (550° F), and under high stress conditions (67,000 psi). Then the materials are made to undergo tensile tests at both room and elevated temperatures. Creep strain results are negligibly small. D.E.R.

N63-14602 Martin Co., Baltimore, Md.

ELASTO-PLASTIC ANALYSIS OF STRUCTURES UNDER LOAD AND TWO-DIMENSIONAL TEMPERATURE DISTRIBUTIONS. VOLUME III: EXPERIMENTAL EVALUATION OF THE GENERAL TIME-DEPENDENT ANALYSIS [Final Report, Feb. 15, 1962-Jan. 1, 1963]

R. J. Edwards, P. C. Huang, J. Mason, B. Jossely, J. Hughes, and E. Marsh Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Mar. 1963 111 p 6 refs
(Contract AF 33(616)-7738)
(RR-35; ASD-TDR-61-667, Vol. III)

This report describes investigations performed to determine experimentally the validity of the time-dependent aspects of a time-dependent, elastoplastic stress and strain analysis method for structures exposed to complex load and two-dimensional elevated temperature environments. An experiment specifically designed to evaluate the accuracy of the theoretical method is presented. This consisted of a test of a long, flat plate subjected to step functions of load randomly combined with several two-dimensional temperature distributions. Magnitude and duration of the test variables were such that plasticity, creep, and appreciable thermal-stress systems were introduced. Comparisons are made of experimental total strains with analytical total strains calculated for conditions identical with the test. The degree of correlation achieved indicates verification of the analysis method within the range of test parameters selected. Author

N63-14630 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.

A SURVEY OF 21 REACTOR VESSELS IN LIGHT OF THE ANTICIPATED EFFECTS OF NEUTRON IRRADIATION ON THE BRITTLE-RUPTURE PROPERTIES OF MATERIALS OF CONSTRUCTION

A. B. Holt Mar. 15, 1963 103 p 19 refs
(TID-17682) OTS: $2.25

This review includes: (1) A comparison of the changes in properties of structural materials produced by neutron irradiation at ambient reactor temperatures wherein it is indicated that (a) the carbon steels and low alloy steels are appreciably more affected than other metals and (b) the effects become more measurable after an integrated neutron flux of 5×10^{18} neutrons/cm^2 and above, and (2) tables indicating the present and future status of a selected number of reactor vessels from the point of view of accumulated neutron dosages. I.v.L.

N63-14640 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham

THE GIVE IN EXPANSIONS OF CORRUGATED TUBES (UBER DIE NACHGIEBIGKEIT VON WELLROHREXPANSIONEN)

F. Salzman Dec. 1962 12 p Transl. from Schweiz. Bauz., v. 127, no. 11, 1946 p 127-130
(TIL/T-5032)

Corrugated tubes may be used to take up expansion differentials between tubes or as sealing members. The give of such tubes under axial forces is investigated for both straight and curved members. Optimum conditions are ascertained. The characteristic magnitude occurring in the theory of cylinder casings is applied. It is shown that the stiffness is greater than that calculated for flat corrugated sheet because of the influence of the ring tensions. Author

N63-14643 Martin Co., Denver, Colo.

BUCKLING OF MISSILE SHELL STRUCTURES UNDER TRANSIENT PRESSURE Informal Report

J. J. Burns, Jr., C. H. Popular, and R. F. Foral May 1962 40 p 4 refs
(IR-62-17)

This report includes a description of the impulse generator used to deliver impulse loadings to shell structures and a description of the instrumentation used to measure and record pressure-time histories and shell behavior. The dynamic buckling phenomenon for 3 manhole covers and the basic tank dome are described. Calibration curves of peak pressure and impulse, including and excluding reflections, versus charge size are presented for a dome located 29½ in. from the impulse-generator exit plane. Sequential photographs of buckling of a full ellipsoidal propellant-tank dome, taken from high-speed motion-picture films are included. Author

N63-14675 Brown U. Div. of Engineering, Providence, R.I.

LONGITUDINAL IMPACT ON VISCO-PLASTIC RODS

Thomas C. T. Ting and P. S. Symonds Feb. 1963 49 p 20 refs
(NSF Grant 17220/5 and ARPA-SD-86)

Hohenemser and Prager proposed a constitutive law for a solid of Bingham type. We use a form of this law to study some cases of longitudinal impact on a bar causing large plastic strains. The results are intended to be of use in the design of impact tests on structural metals and in the interpretation of data from them, as well as helpful in guiding similar studies on materials with more complex plastic strain-rate behavior. Author

N63-14705 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

SOME RECENT STUDIES IN STRUCTURAL DYNAMICS OF ROTOR AIRCRAFT

George W. Brooks and Milton A. Silveira *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 285-299 5 refs (See N63-14683 10-04)

This paper presents a summary of four recent studies relating to the structural-dynamics problems of rotor-powered aircraft. The first study concerns the measurement by means of dynamic models of the forces and moments at the hubs of various rotor configurations. The results of this study show that the periodic components of the forces and moments are highly dependent on both the rotor configuration and the flight condition. The second study treats the problem of resonance amplifications of rotor-blade stress and shows that by using multiple flapping hinges or flex-joints it is possible to control the natural frequencies of the rotor blade so that conditions of resonance between the frequencies of the aerodynamic input forces and the natural frequencies of the lower blade modes are avoided for all rotor speeds. Two studies of the stability of rotor aircraft are also discussed. One of these involves the mechanical instability or ground resonance of rotorcraft wherein the rotor support in each of two mutually perpendicular directions in the rotor plane is represented as a multiple-degree-of-freedom system in contrast to the system having a "single" degree of freedom normally used in helicopter analysis. The consideration of the rotor support system as a two-degree-of-freedom system predicts additional unstable ranges of rotor speed not predicted by former analyses. The other instability treated is propeller whirl for which the significant motions are the pitching and yawing motions of the propeller disk which are coupled together by gyroscopic forces. The effect of the significant variables on the instability is presented and shows that the speed at which the instability occurs can be increased by increasing the relative stiffness of the propeller in the pitch and yaw directions or by increasing the effective structural damping of the nacelle. Author

N63-14706 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

STRUCTURAL-LOADS SURVEYS ON TWO TILT-WING VTOL CONFIGURATIONS

John F. Ward *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 301-313 2 refs (See N63-14683 10-04)

The results of two structural-loads surveys are summarized. The first loads program discussed concerns the airframe vibratory loads encountered during flight tests of the VZ-2 tilt-wing VTOL aircraft throughout the operational range from hover to cruise flight. The primary sources of airframe vibration were wing-stall buffeting and tail buffeting in descents. The second loads program discussed concerns the initial results of a structural-loads survey conducted as part of the wind-tunnel test of a large-scale tilt-wing research model. This loads program deals with the steady wing loads measured throughout simulated transition from hover to cruise. Author

N63-14707 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

SUMMARY OF ROTOR-BLADE VIBRATORY-LOAD STUDIES

LeRoy H. Ludi *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 315-324 8 refs (See N63-14683 10-04)

The results of rotor-blade vibratory-load studies with helicopters are reviewed. These studies covered all flight regimes and indicate that severe rotor-blade loads can be expected to occur during high-speed level flight, landing approaches, partial-power descents, and droop-stop pounding during rotor operation on the ground. In addition, retreating-blade stall can cause increased torsional moments which cause increased control loads. In the future design of rotorcraft, these severe rotor-blade loads must be accurately accounted for in component fatigue-life determinations so that undue limitations will not seriously restrict the operational usage of the rotorcraft. R.C.M.

N63-14708 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

FACTORS IN EVALUATING FATIGUE LIFE ON STRUCTURAL PARTS

Walter Illg *In its* NASA Conference on V/Stol Aircraft, Langley Research Center, Langley Field, Va., Nov. 17-18, 1960 p 325-354 4 refs (See N63-14683 10-04)

Three facets of fatigue testing are discussed in relation to problems involved in evaluating the fatigue life of structural parts. These facets are variable-amplitude loading, fatigue-crack propagation, and equivalent fatigue loading. Experimental test results are included to support conclusions. Author

N63-14716 Ohio State U., Columbus

THERMAL STRESSES DUE TO LARGE SPANWISE TEMPERATURE GRADIENTS IN LONG THIN PLATES

B. E. Gatewood, R. G. Dale, and A. R. Glaser Wright-Patterson AFB, Ohio, Aeronautical Research Lab., Jan. 1963 70 p 18 refs
(Contract AF 33(616)-8330)
(ARL 63-4)

This report contains the results of a theoretical and experimental investigation of the thermal strains and stresses produced in unrestrained, long, thin rectangular plates by large spanwise temperature gradients. The temperature distribution is steady state, and the stress distribution approximates the two-dimensional "plane stress" solution of elasticity theory. Two temperature gradients were investigated, one in which the temperature changed about 150° F over a five-inch distance, and one in which the temperature changed about 70° F over a one-inch distance. It was found that for these relatively large temperature gradients, the solutions for the thermal stresses given in the literature were either not applicable or were impractical because of the large number of terms required in the series-type solutions. By converting one of the available Fourier Series solutions into a Fourier Integral and using residues and superposition, it is possible to construct a solution for the stresses in which only a few terms are needed in the series for the residues. The calculated thermal strains compare reasonably well with the experimental results, although there is considerable scatter in the strain-gage results on the tests. Author

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-14407 Naval Ordnance Lab., White Oak, Md.

FUTURE STUDY AREAS IN REINFORCED PLASTICS FOR UNDERWATER ORDNANCE AND DEEP SUBMERGENCE CONSTRUCTIONS

F. Robert Barnet Feb. 1963 46 p 6 refs
(NOLTR-62-206)

There are still performance problems with glass laminates, due to their anisotropic and viscoelastic nature, to be more fully understood and solved in the areas of creep, fatigue, resistance to shock loadings, and the engineering of joints, openings, and attachments in structures. These problems, which one may expect will be aggravated by the very high pressures to be withstood in the new application, are the subject of this report, and are broadly discussed in terms of future work plans. Specific study programs on general external-pressure-vessel problems are also suggested. Author

N63-14676 Beech Aircraft Corp., Boulder, Colo.

ESTABLISHING DESIGN CRITERIA FOR LIQUID HYDROGEN ROCKETS. VOLUME III—MATERIALS FOR LIQUID HYDROGEN BOOST TANKS Final Report [Dec. 1958-Sept. 1961]

J. E. Bell and H. E. Sutton May 1962 147 p 28 refs
(Contract AF 33(616)-5154)
(AFFTC-TR-60-43, Vol. III)

Materials have been evaluated for use in fabrication of liquid hydrogen tanks for boosters and spacecraft. The criteria for material selection were for a 7000-gallon tank with optimum strength-to-weight ratio in the temperature range from −423° F to 1000° F. The areas covered include the selection and testing of materials for tank structure, insulation, and encapsulation. R.C.M.

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